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WATER QUALITY IN THE CALUMET AREA. CONFERENCE ON POLLUTION OF LOWER LAKE MICHIGAN, CALUMET RIVER, GRAND CALUMET RIVER, LITTLE CALUMET RIVER, AND WOLF LAKE, ILLINOIS AND INDIANA

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Results on the water quality indicate no significant change since 1965 in spite of the accomplishments in pollution control. The Calumet Area Water Quality Committee reviewed the criteria to determine the reasons for the lack of improvement in water quality and to determine what actions are required to achieve satisfactory water quality in the area.

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WATER QUALITY IN THE CALUMET AREA

CONFERENCE ON POLLUTION OF LOWER LAKE MICHIGAN, CALUMET RIVER,
GRAND CALUMET RIVER, LITTLE CALUMET RIVER, AND WOLF LAKE,
ILLINOIS AND INDIANA

TECHNICAL COMMITTEE ON WATER QUALITY
SEPTEMBER 1970

TABLE OF CONTENTS

		Page
I.	INTRODUCTION.....	1
II.	CONCLUSIONS AND RECOMMENDATIONS.....	3
III.	WATER USES.....	13
IV.	WASTE SOURCES.....	14
V.	PRESENT WATER QUALITY CRITERIA.....	41
VI.	PRESENT WATER QUALITY.....	42
VII.	FUTURE WATER QUALITY.....	124

LIST OF TABLES

Table Number	Title	Page Number
1.	Water Uses.....	13
2.	Municipal Sewage Treatment-Indiana-Annual Average of Analysis from Monthly Reports.....	18
3.	Summary of Industrial Effluent Data-1968-Indiana-Grand Calumet River and Indiana Harbor Ship Canal.....	22
4.	Interlake Steel-Chicago-Blast Furnace and Sinter Plant-Pounds per Day Discharged.....	34
5.	Interlake Steel-Chicago Riverdale Plant-Pounds per Day Discharged.....	38
6.	Municipal Waste Load-Lake Side of O'Brien Locks-Metropolitan Sanitary District 95th Street Pumping Station....	39
7.	Summary of Water Quality Measurements-Station 1 Grand Calumet River at Pennsylvania Railroad Bridge.....	45
8.	Summary of Evaluations of Trends in Water Quality-Station 1 Grand Calumet River at Pennsylvania Railroad Bridge....	46
9.	Summary of Water Quality Measurements-Station 2 Indiana Harbor Canal-151st Street Bridge.....	48
10.	Summary of Evaluations of Trends in Water Quality-Station 2 Indiana Harbor Canal-151st Street Bridge.....	49
11.	Summary of Water Quality Measurements-Station 3 Indiana Harbor Canal at Dickey Road Bridge.....	51
12.	Summary of Evaluations of Trends in Water Quality-Station 3 Indiana Harbor Canal at Dickey Road Bridge.....	52
13.	Summary of Water Quality Measurements-Station 4 Indiana Harbor Canal at Pierhead Lights.....	54
14.	Summary of Water Quality Measurements-Station 6 Indiana Harbor at East Breakwall Inner Light.....	55
15.	Summary of Violations of Water Quality Criteria-Station 6 Indiana Harbor Canal at East Breakwall Inner Light.....	57

LIST OF TABLES

Table Number	Title	Page Number
16.	Summary of Evaluation of Trends in Water Quality-Station 4 Indiana Harbor Canal at Pierhead Lights.....	60
17.	Summary of Evaluation of Trends in Water Quality-Station 6 Indiana Harbor at East Breakwall Inner Light.....	61
18.	Summary of Water Quality Measurements-Station 7 Grand Calumet River at Indiana Belt RR Bridge.....	64
19.	Summary of Violations of Water Quality Criteria-Station 7 Grand Calumet River at Indiana Belt RR Bridge.....	65
20.	Summary of Evaluations of Trends in Water Quality-Station 7 Grand Calumet River at Indiana Harbor Belt RR Bridge...	67
21.	Summary of Water Quality Measurements-Station 8 Little Calumet River at Wentworth Avenue.....	68
22.	Summary of Violations of Water Quality Criteria-Station 8 Little Calumet River at Wentworth Avenue.....	69
23.	Summary of Evaluations of Trends in Water Quality-Station 8 Little Calumet River at Wentworth Avenue.....	71
24.	Summary of Water Quality Measurements-Station 9 Wolf Lake at Indiana-Illinois State Line Culvert.....	75
25.	Summary of Water Quality Measurements-Station 10 Wolf Lake Outlet at Carondolet Avenue.....	76
26.	Summary of Violations of Water Quality Criteria-Station 9 Wolf Lake at Indiana-Illinois State Line Culvert.....	77
27.	Summary of Violations of Water Quality Criteria-Station 10 Wolf Lake Outlet at Carondolet Avenue.....	78
28.	Summary of Evaluations of Trends in Water Quality-Station 9 Wolf Lake at Indiana-Illinois State Line Culvert.....	79
29.	Summary of Evaluations of Trends in Water Quality-Station 10 Wolf Lake Outlet at Carondolet Avenue.....	80
30.	Summary of Water Quality Measurements-Station 11 Calumet River at Mouth.....	81

LIST OF TABLES

Table Number	Title	Page Number
31.	Summary of Water Quality Measurements-Station 13 Calumet Harbor	82
32.	Summary of Violations of Water Quality Criteria-Station 11 Calumet River at Mouth	83
33.	Summary of Evaluations of Trends in Water Quality-Station 11 Calumet River at Mouth	85
34.	Summary of Evaluations of Trends in Water Quality-Station 13 Calumet Harbor	86
35.	Summary of Water Quality Measurements-Station 14 Gary-West Water Plant Intake	90
36.	Summary of Water Quality Measurements-Station 15 East Chicago Water Plant Intake	91
37.	Summary of Water Quality Measurements-Station 16 Hammond Water Plant Intake	92
38.	Summary of Water Quality Measurements-Station 17 Chicago South Water Plant Intake	93
39.	Summary of Violations of Water Quality Criteria-Stations 14, 15, 16, and 17	94
40.	Summary of Cold Weather Water Quality Measurements of Parameters Which Violated Water Quality Criteria-Stations 14, 15, 16, and 17	101
41.	Summary of Evaluations of Trends in Water Quality-Station 14 Gary-West Water Plant Intake	103
42.	Summary of Evaluations of Trends in Water Quality-Station 15 East Chicago Water Plant Intake	104
43.	Summary of Evaluations of Trends in Water Quality-Station 16 Hammond Water Plant Intake	105
44.	Summary of Evaluations of Trends in Water Quality-Station 17 Chicago South Water Plant Intake	106

LIST OF TABLES

Table Number	Title	Page Number
45.	Summary of Heavy Metal Measurements-Station 16 Hammond Water Plant Intake.....	107
46.	Summary of Water Quality Measurements-Calumet River.....	109
47.	Summary of Evaluations of Trends in Water Quality-Calumet River-Lake Side of O'Brien Locks.....	111
48.	Frequency of Criteria Violations at Calumet Area Beaches.	123

LIST OF FIGURES

Figure Number	Title	Page Number
1.	Storm and Combined Sewer Overflows-Indiana.....	30
2.	Metropolitan Sanitary District of Greater Chicago-Combined Sewer Overflows.....	40
3.	Location Map-Stations 1 through 17.....	43
4.	Beaches, Water-Oriented Parks and Marinas, Calumet Area..	113
5.	Beach Sampling Results-Total Coliforms.....	120
6.	Beach Sampling Results-Fecal Strep.....	121
7.	Beach Sampling Results-Fecal Coliform.....	122
8.	Location Map-Calumet Area.....	Last

I. INTRODUCTION

Conference Background. A public conference on pollution of the interstate waters of the Grand Calumet River, Little Calumet River, Calumet River, Wolf Lake, Lake Michigan and tributaries (Figure 8) was held in Chicago, Illinois during March 2 thru 9, 1965. The conference was called by the Secretary of Health, Education and Welfare under the provisions of Section 8 of the Federal Water Pollution Control Act (33 USC 466 et.seq.) and included representatives of the Illinois Sanitary Water Board, the Indiana Stream Pollution Control Board, the Metropolitan Sanitary District of Greater Chicago and the United States Public Health Service. (This function has since been transferred to the Federal Water Pollution Control Administration.)*

On March 15, 1967 and September 11, 1967, progress evaluation meetings were held which indicated a great deal of work was being done to abate pollution, but that the water quality in the area did not significantly improve.

On December 11, 1968, a third progress evaluation meeting was held which indicated that most of the industries and all but one municipality were in compliance with the requirements. Several large steel mills indicated that they would require more time to complete their pollution abatement programs and requested an extension of the deadline. Reports on the water quality indicated no significant change since 1965 in spite of the accomplishments in pollution control. The conferees appointed the Calumet Area Water Quality Committee to review the criteria in view of the large amount of data gathered by

*The Water Quality Improvement Act of 1970 changed the name of this agency to the Federal Water Quality Administration.

the surveillance activities, determine the reasons for the lack of improvement in water quality, and determine what actions are required to achieve satisfactory water quality in the area. The members of the committee are:

*F. T. Mayo	-	Federal Water Pollution Control Administration
**B. T. Lynam	-	Metropolitan Sanitary District of Greater Chicago
R. S. Nelle	-	Illinois Sanitary Water Board
O. Hert	-	Indiana Stream Pollution Control Board

*Replaced H. W. Poston, the original member from the Federal Water Pollution Control Administration, effective 2/2/70.

**Replaced Dr. J. Stein, the original member from the Metropolitan Sanitary District of Greater Chicago, effective 7/8/69. Mr. Lynam was replaced by Dr. D. T. Lordi, effective 7/29/70.

II. CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

1. All of the water quality criteria will not be met at all control points in the Calumet Area, even when the pollution abatement measures presently under construction to comply with Calumet Area Conference requirements are completed. Additional abatement measures will be necessary to meet the Water Quality Criteria.

2. Improvements have been made in pollution control facilities, and the effects of these improvements are shown in improved water quality at some locations.

3. Water quality based on measurements at water quality monitoring stations:

(a) Open Water. Two important parameters, threshold odor and oil and grease, both associated with water treatment problems, indicate a deterioration in water quality. Other parameters show either an improvement or no apparent change in water quality. Total phosphorous, an essential plant nutrient, shows no apparent change.

(b) Inner Harbor Basin. Oil and grease, a parameter of significance in water treatment, has caused a deterioration of water quality. Most other parameters indicate either an improvement or no apparent change. Total phosphorous shows no apparent change.

(c) Shore Water. No significant change.

(d) Grand Calumet River-Indiana Harbor Canal. Improved.

(e) Grand Calumet River-West to Illinois. Deteriorated.

(f) Little Calumet River-West to Illinois. No significant change.

(g) Wolf Lake. No significant change - except bacterial water quality has deteriorated at Hammond beach.

(h) Calumet River-Lake Side of O'Brien Locks. No significant change except at the mouth where water quality has improved.

4. Violations of water quality criteria are frequent and often severe. This is caused by intermittent waste discharges as well as inadequate treatment provided at some locations.

5. All planned pollution abatement measures were not completed at the time of this study (1969), and this is an important reason why more of the water quality criteria were not met.

(a) Industrial waste treatment plants, especially at some large steel mills, were not completed.

(b) The Hammond Sanitary District and the East Chicago Sanitary District have expanded their sewer systems and have accepted additional industrial wastes so that their plants have become overloaded. Industrial wastes are adversely affecting the degree of treatment provided in these municipal treatment plants.

6. The increased domestic and industrial waste flows added to the combined sewer systems have aggravated the serious problems of combined sewer overflows.

7. Improvements are planned for the control of combined sewer overflows and for better treatment at the municipal waste treatment plants.

8. A comparison of water quality measurements at Station 11 at the mouth of the Calumet River, Station 6 at the mouth of the Indiana

Harbor Canal, and Station 16 at the Hammond Water Supply Intake showed that when specific water quality criteria were met at Stations 11 and 6, those water quality criteria were generally not violated at Station 16. Comparisons of water quality measurements at Station 16 with the three other Lake Michigan sampling stations (Figure 3) showed that a measured improvement in water quality at the other Lake Michigan sampling stations generally occurred concurrently with a measured improvement in water quality at Station 16.

9. Pollution Abatement Measures Required.

(a) MUNICIPAL POLLUTION ABATEMENT MEASURES REQUIRED

Municipality or Sanitary District / Location of Discharge	Facilities Required	Enforcement Agency Scheduled Completion Date	Completion Date Recommended by Committee, Not Later Than
	INDIANA		
Hammond Sanitary District Grand Calumet River and Little Calumet River and Wolf Lake	a) Combined sewer overflows eliminated or controlled	7-1-77	7-1-77
	b) Polluted storm sewer discharges eliminated or pollution controlled	None	7-1-77
Grand Calumet River	c) Sewage treatment plant additions and advanced waste treatment *	12-31-72	12-31-72
Lake Michigan	d) Polluted storm sewer discharge control	12-31-70	12-31-70

(a) MUNICIPAL POLLUTION ABATEMENT MEASURES REQUIRED (continued)

Municipality or Sanitary District Location of Discharge	Facilities Required	Enforcement Agency Scheduled Completion Date	Completion Date Recommended by Committee, Not Later Than
	INDIANA (Continued)		
City of Whiting Lake Michigan	a) Combined sewer overflows eliminated	12-31-70	12-31-70
	b) Polluted storm sewer discharges eliminated or pollution controlled	12-31-70	12-31-70
Gary Sanitary District Grand Calumet River	a) Combined sewer overflows eliminated or pollution controlled	7-1-77	7-1-77
	b) Polluted storm sewer discharges eliminated or pollution controlled	None	7-1-77
	c) Phosphorous reduction	12-31-72	12-31-72
	d) Advanced waste treatment	7-1-77	7-1-77
East Chicago Sanitary District Grand Calumet River	a) Combined sewer overflows eliminated	7-1-77	7-1-77
	b) Polluted storm sewer discharges eliminated or pollution controlled	None	7-1-77
	c) Phosphorous reduction	12-31-72	12-31-72
	d) Advanced waste treatment	7-1-77	7-1-77

(a) MUNICIPAL POLLUTION ABATEMENT MEASURES REQUIRED (continued)

Municipality or Sanitary District Location of Discharge	Facilities Required	Enforcement Agency Scheduled Completion Date	Completion Date Recommended by Committee, Not Later Than
	INDIANA (Continued)		
Municipalities of Munster, Highland, and Griffith Little Calumet River	a) Combined sewer overflows eliminated or pollution controlled	7-1-77	7-1-77
	b) Polluted storm sewer discharges eliminated or pollution controlled	None	7-1-77
	ILLINOIS		
Metropolitan Sanitary District of Greater Chicago Calumet River	a) Combined sewer overflows eliminated or pollution controlled	6-28-77	7-1-77
	b) Polluted storm sewer discharges eliminated or pollution controlled	7-1-77	7-1-77

Note: Control of pollution from combined sewer overflows and phosphorous reduction are requirements of the Lake Michigan Four State - Federal Enforcement Conference.

(b) INDUSTRIAL POLLUTION ABATEMENT MEASURES REQUIRED

Industry Location of Discharge	Facilities Required	Industry Proposed Completion Date
	INDIANA	
American Maize Products Co. Lake Michigan	Advanced Waste Treatment	12/1/72
American Oil Lake Michigan	Advanced Waste Treatment	12/31/70
Atlantic Richfield (Sinclair) Indiana Harbor	Advanced Waste Treatment	8/1/70
Cities Service Indiana Harbor	Advanced Waste Treatment	7/1/71
Inland Steel Indiana Harbor	Terminal Treatment	5/1/70, completed - operation being evaluated
U. S. Gypsum Co. Indiana Harbor	Additional Treatment	6/1/72, evaluation of earlier work showed need for further improvement
U. S. Steel Grand Calumet River	Additional Treatment	12/31/72, evaluation of earlier work showed need for further improvement
Youngstown Steel Indiana Harbor	Terminal Treatment	6/30/70, completed - operation being evaluated

(b) INDUSTRIAL POLLUTION ABATEMENT MEASURES REQUIRED (continued)

Industry Location of Discharge	Facilities Required	Industry Proposed Completion Date
	ILLINOIS	
Cargill Corporation Calumet River	a) Industrial-advanced waste treatment	(Industry in litigation)
	b) Sanitary waste	(Industry in litigation)
Interlake Steel Chicago Plant Calumet River	Recycle blast furnance scrubber water and sinter plant waste	Completed 2/28/70, operation being evaluated (Industry in litigation)
Wisconsin Steel Calumet River	High rate filter system and sewer changes	(Industry in litigation)
Republic Steel Calumet River	Three clarifiers, chemical treatment, and new deep bed filter system	12/31/70 (Industry in litigation)
United States Steel South Works Calumet River and Lake Michigan	a) Terminal treatment plant	12/31/70 (Industry in litigation)
	b) Blast furnance recycle system	11/30/70

*The following definition of advanced waste treatment was taken from "Summary Report-Advanced Waste Treatment-July, 1964-July, 1967," publication WP-20-AWTR-19, published by Advanced Waste Treatment Branch, Robert A. Taft Sanitary Engineering Center, Federal Water Quality Administration, Cincinnati, Ohio, 1968. "Advanced waste treatment

refers to methods and processes that will remove more contaminants from wastewater than are usually removed in present day conventional treatment plants. The processes may be physical-chemical, or biological. Although the term "tertiary" is often used as a synonym for advanced treatment methods, the two are not precisely the same. Tertiary suggests a single treatment to be applied only after conventional primary and secondary treatment. The advanced treatment techniques may be used after conventional treatment, or they may modify or replace one or more steps comprising present conventional treatment. For example, if chemicals are added in the conventional activated sludge biological process to precipitate phosphorus, this is advanced treatment." The suitability of one or more advanced waste treatment processes at a particular location will depend on the treatment required to meet water quality standards.

RECOMMENDATIONS

1. Because of the observed continued build-up of pollutants in Lake Michigan waters, due to the accelerated development of the area and to the limitations inherent in the operation of wastewater treatment plants, it is necessary to consider long-range programs to protect the Lake. Recycling of industrial process water and re-use of municipal waste treatment effluents should be programmed.

2. Combined sewer overflows should be eliminated or pollution controlled as soon as possible and not later than July 1, 1977.

3. Although joint municipal-industrial waste treatment systems are encouraged, municipalities should accept industrial wastes in their

sewer systems only if adequate collection and treatment facilities are available and the approval of the regulatory agency is obtained.

4. Each regulatory agency should require contingency plans to prevent stream damage caused by spills and equipment breakdowns at municipal and industrial facilities.

5. Adequate and consistent effluent criteria should be established in the conference area for use until the completion of recycle facilities.

6. Docking areas should be provided with the necessary on-shore disposal facilities for vessel wastes.

7. A control point should be established at the 151st Street bridge over the Indiana Harbor Canal immediately downstream from the junction of the east and west portions of the Grand Calumet River (Station 2), using the criteria for the Grand Calumet River (SPC 8 - Indiana).

8. In addition to the requirement that the waters be substantially free of visible floating oil, a numerical limit of 10 mg/l single daily value or average and 5 mg/l annual average as measured by hexane solubles should be established for the Little Calumet River (Station 8 control point), Grand Calumet River (Station 7 control point), Calumet River (Station 11 proposed as control point), and Indiana Harbor Canal (Station 6 control point).

9. A control point should be established at the mouth of the Calumet River immediately adjacent to the north pierhead light (Station 11) using criteria from Illinois SWB 15, Rule 1.05, Calumet Harbor Basin Criteria, which is identical to Indiana SPC 6 Lake Michigan Inner Harbor Basin Criteria.

10. Industrial waste analyses should be made daily by all industries on separate composite samples from each outfall. The same analyses for the same time period should be made on the intake water so that the net waste load can be calculated.

11. Since water quality and progress in water pollution abatement can only be accurately determined by water quality measurements, the Federal Water Quality Administration Surveillance Program should be continued, and an adequate surveillance program for water quality in the Calumet River between O'Brien Locks and Lake Michigan should be implemented.

III. WATER USES

The existing water uses are shown in Table 1. As demands on the water resource increase, more water uses may be accommodated in the future. Also, as advances in pollution abatement technology are made, the water quality required for specific uses may be increased.

TABLE 1
EXISTING WATER USES

AREA AS DEFINED / USES	Municipal Water Supply	Industrial Water Supply	Recreation - Whole Body Contact	Recreation - Limited Body Contact	Fish and Wildlife	Commercial Shipping	Esthetics
Open Water	X	X	X	X	X	X	X
Inner Harbor Basins	X	X	X	X	X	X	X
Shore Water	X	X	X	X	X		X
Little Calumet River				X			X
Grand Calumet River		X					X
Wolf Lake			X	X	X		X
Indiana Harbor Canal		X				X	X
Calumet River		X				X	X

IV. WASTE SOURCES

Indiana.

(a) Municipal.

(1) Little Calumet River - West to Illinois. The municipalities of Dyer and Schererville completed construction of sewage treatment facilities, including effluent chlorination, in 1966 and 1965, respectively. The 1968 monthly operating reports and supervisory visits show the plants are operating at about 1/2 of the design capacity and are turning out effluents in the range of 5 to 10 mg/l in terms of 5-day BOD. The municipality of Munster is a part of the Hammond Sanitary District, and Highland and Griffith are connected to the District by contract. The dry weather flow from these three municipalities is discharged to the District for treatment.

All dry weather sewage flow from sewered areas in the Indiana tributary area receives treatment. The overflow from combined sewers and storm sewers is the major cause of unsatisfactory conditions in the receiving stream. It should be noted that in addition to the municipalities mentioned above, the Hammond Sanitary District has combined sewer overflows and storm relief pumping stations discharging to this watershed. Water quality criteria in the tributary area will not be met until the overflow from the storm and combined sewers receives adequate treatment and control.

(2) Grand Calumet River - West to Illinois. The Hammond Sanitary District provides interceptor sewers and sewage treatment for the City of Hammond and the Town of Munster which are within the

District boundaries and sewage treatment by contract for the municipalities of Griffith, Highland, and Whiting. The majority of the area is served by combined sewers, with overflows during wet weather periods to the Grand Calumet River, Little Calumet River, Wolf Lake, and Lake Michigan. A separate storm water system also discharges to Wolf Lake. Treatment and/or control of storm and combined sewer overflows must be provided. Facilities to provide treatment and disinfection of the storm water overflow discharges to Lake Michigan by both Hammond and Whiting are to be provided on or before the end of 1970.

The Hammond Sanitary District plant, which provides effluent chlorination, is designed to treat a flow of 36 mgd. The normal flow of the discharge is west to Illinois. However, certain hydraulic conditions may cause flow eastward to Lake Michigan. Although the yearly flow in the past three years has averaged from 32 to 35 mgd, daily flows above 40 mgd are reported routinely. The effluent quality, which averaged 39 mg/l in terms of BOD and 37 mg/l in terms of suspended solids in 1968, has deteriorated since 1965. The effluent is not satisfactory and the District has been advised that expansion will be required on or before the end of 1972 to provide at least 95 percent treatment.

(3) Grand Calumet River-Indiana Harbor Canal. The Gary Sanitary District serves the City of Gary and the area within the District boundaries plus the municipalities of Merrillville and East Gary by contract. The majority of the Gary area is served by combined sewers; however, Merrillville and East Gary are essentially separate sewer systems. The City of East Gary is now served by an old plant consisting

of an Imhoff tank, trickling filter, and final settling tank including effluent chlorination with discharge to Burns Ditch; however, under a new agreement, East Gary will discharge its sewage to a Gary interceptor for treatment at the main District plant.

The District plant is designed to provide at least primary treatment for 80 mgd; however, under current operating conditions secondary treatment capability is about 60 mgd. Effluent chlorination is provided. The average flow to the plant increased from 42.1 mgd in 1966 to 48.5 mgd in 1968; however, most of this increase was brought about by more effective operation of overflow structures and interception of additional flow. The velocity in the interceptors is low during low flow periods and solids that settle out are flushed to the plant and to overflow points during wet weather periods. Consulting engineers are preparing preliminary reports on needed sewer system and plant improvements. Monthly reports of operation show an annual average effluent BOD of 11 mg/l and suspended solids of 21 mg/l.

Phosphorus removal facilities to achieve at least 80 percent reduction are to be provided by 1972. In addition, facilities must be provided for treatment and/or control of pollution from storm and combined sewer overflows.

The East Chicago Sanitary District serves the City of East Chicago. The majority of the area is served by combined sewers. However, plans have been approved for some sewer separation, and a storm water demonstration project (supported by a FWPCA grant) to divert storm water flows from approximately 1/3 of the City area to

a deep water detention lagoon is under way. Treatment and/or control of storm and combined sewer overflows will be required to meet water quality criteria in the receiving stream.

The sewage treatment plant, which is designed for 20 mgd based on the Guggenheim Biochemical Process, is receiving an average flow of 11 to 12 mgd. At design flow the facilities would provide 1.15 hours primary settling, 2.04 hours aeration (with 20 percent return sludge), and 1.7 hours final settling. The plant is partially operated as a Guggenheim process in that 600 pounds of alum is added to the aeration tanks each day. Over the past two or three years, increasing amounts of industrial wastes have been connected and effluent quality has deteriorated. Data on influent and effluent analyses are shown in Table 2. Although effluent chlorination has been provided, with contact time in the open channel to the river, the increasing amounts of ammonia have rendered disinfection ineffective.

The storm water demonstration project also provides for the discharge of plant effluent to the deep water detention lagoon. In addition, a 0.75 mgd pilot plant for advanced waste treatment, which is just going into operation, has provision for taking effluent from the detention lagoon when it is operational. The objective of the pilot plant studies is to develop an effective program for advanced waste treatment of all wastewater discharged to the interceptor sewer system. It appears that advanced waste treatment will be necessary to meet water quality criteria in the receiving waters. Phosphorus reduction is required on or before the end of 1972.

TABLE 2
MUNICIPAL SEWAGE TREATMENT - INDIANA
ANNUAL AVERAGE OF ANALYSIS FROM MONTHLY REPORTS

Municipality	Year	STP Design Cap. (mgd)	Flow mg/d	BOD (mg/l) Raw	BOD (mg/l) Final	Susp. Solids (mg/l) Raw	Susp. Solids (mg/l) Final
Dyer	1968	0.60	0.285	145	5	-	-
Schererville	1968	0.86	0.325	111	10	118	13
Hammond	1966	36.00	35.1	182	22	264	23
	1967		32.1	156	21	252	27
	1968		33.0	223	39	407	37
Gary	1966	60.00	42.1	142	10	-	43
	1967		46.1	89	16	239	43
	1968		48.5	101	11	200	21
East Chicago	1966	20.00	11.3	91	9	103	12
	1967		11.8	154	16	110	18
	1968		11.5	150	28	111	27

SPECIAL EFFLUENT ANALYSIS (MG/L)

Municipality	Year	NH_3	Nitrate	Phenol	Iron	Phosphorus	Cn
East Chicago	1966	18.9	-	0.009	-	3.6	0.18
	1967	23.6	-	0.010	-	2.8	0.19
	1968	48.5	0.71	0.232	1.6	3.8	0.28

The East Chicago collection and interceptor sewer systems do not at this time deliver all dry weather flow to the treatment plant. Some of the industrial wastewater accepted by the District is now discharged to the Indiana Harbor Canal without treatment. Sewer and lift station improvements approved by the Board and scheduled for construction in 1969 will abate this condition.

(b) Industrial. Three industries originally involved in the Conference have closed operations. These are: Barry Refining Company, Gary; Calumet Nitrogen Products Corporation, Whiting; and Adolph Plating Corporation, East Chicago.

Inspections by representatives of the Stream Pollution Control Board show that the following industries continue to maintain adequate waste treatment and/or control as documented in past reports to the Conference:

1. Vulcan Materials Corporation, Metallics Division, Gary
2. U. S. S. Lead Refinery, East Chicago
3. General American Transportation Corporation, East Chicago
4. Blaw Knox Company, East Chicago
5. American Steel Foundries, East Chicago
6. Union Carbide Corporation, Linde Division, East. Chicago
7. Union Tank Car Company, Whiting
8. U. S. Steel Corporation, American Bridge Division, Gary
9. Northern Indiana Public Service Company, Baileytown
10. Northern Indiana Public Service Company, Gary

11. U. S. Steel Corporation, Universal Atlas Division, Gary

12. Commonwealth Edison Company of Indiana, Hammond

13. M & T Chemicals, East Chicago

(1) Little Calumet River - West (to Illinois). Simmons Company, Munster, the only industry on this watershed that discharges treated effluent to the receiving stream, continues to provide adequate treatment and control.

(2) Grand Calumet River - West (to Illinois). LaSalle Steel Company, Hammond is the only industry located on this portion of the Grand Calumet River. The 1969 effluent monitoring reports through August show that the suspended solids content in the effluent averaged 42 mg/l with a daily flow of 20,000 gpd. This is an improvement over the 1968 report data. The Company has obtained permission from the Hammond Sanitary District to connect the neutralized acid waste to the District's sewerage system. The connection was during late 1969.

(3) Wolf Lake. Lever Brothers Company is the only industry discharging treated wastewater into Wolf Lake Channel. The Company continues to work toward better wastewater treatment and control to improve conditions in the Channel as specified under the stipulation agreed to during 1963.

The 1969 monitoring data through August show that the effluent, 4.83 mgd averaged 23 mg/l for BOD. At least a 50 percent reduction in BOD was achieved during February, 1969, when a scrubvactor was installed on a still in the fatty acid department to control losses of fatty acid. During April, a glycerin still in the

glycerin department was shut down for studies and development of controls to minimize losses of glycerin. The reduction in BOD should substantially improve conditions in Wolf Lake Channel. Effluent BOD's are now averaging 10 to 15 mg/l.

(4) Grand Calumet River - Indiana Harbor Canal. Since December 11, 1968, many waste treatment facilities have been completed at industries located within this portion of the Basin and many facilities, basically at the steel mills, are under construction. The recently completed projects and those under construction should substantially reduce the wastewater loadings outlined in Table 3. A brief summary of the status of projects at the various industries is as follows:

(a) E. I. du Pont de Nemours and Company, Inc., East Chicago. Durling late 1968, the industry completed construction of improvements to the acid neutralization facilities and solids removal facilities for removal of solids from the Ludox operation. Approximately 6,000 pounds per day of chlorides, 500 pounds per day of zinc and 1,000 pounds per day of suspended solids have been eliminated.

(b) Mobil Oil Company, East Chicago. Construction was completed on the air flotation unit on April 30, 1969. After 4 months of evaluation it has been noted that oil and suspended solids have been reduced by approximately 50 percent. The industry began reuse of the treated wastewater as cooling tower make-up water in late 1969 which should provide substantial reductions in BOD and phenol-type compounds.

(c) Sinclair Refining Company, East Chicago. The Company completed construction of sludge dewatering facilities, presettling tank and storm water retention facilities during late 1968.

TABLE 3

SUMMARY OF INDUSTRIAL EFFLUENT DATA - 1968 - INDIANA
GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL

Industry	Flow mgd	BOD pounds /day	Suspended Solids pounds/day	Oil pounds /day	Phenol pounds /day	NH_3 pounds /day	Cyanide pounds /day
U. S. Steel Corporation Gary	536.9		224,088	48,821	91	377	
Georgia Pacific Corporation, Gary	1.5	3,500	6,250	500			
Cities Service Oil Company East Chicago	63.0	3,872	5,741	2,252	82	398	
E. I. duPont de Nemours East Chicago	1.9		1,009				
Union Carbide Corporation Linde Division East Chicago	.2		12	15			
Mobil Oil Company East Chicago	2.7	1,897	1,244	432	89	106	
Sinclair Oil Company East Chicago	3.9	4,419	1,230	1,700	111	520	
U. S. Gypsum Company East Chicago	3.4		625				
Union Carbide Corporation Chemicals Division (East Chicago outlet)	.02	4	1	1			

TABLE 3 (CONTINUED)

SUMMARY OF INDUSTRIAL EFFLUENT DATA - 1968 - INDIANA
GRAND CALUMET RIVER AND INDIANA HARBOR SHIP CANAL

Industry	Flow mgd	BOD pounds /day	Suspended Solids pounds/day	Oil pounds /day	Phenol pounds /day	NH_3 pounds /day	Cyanide pounds /day
Adolph Plating Company East Chicago	.3		210	39			480
LaSalle Steel Company Hammond	.02		110				
Youngstown Sheet & Tube East Chicago	324.9		74,347	15,715			
Inland Steel Company East Chicago	975.6		127,363	37,194	639	3,562	372
Lake Michigan							
American Oil Company Whiting	127.1	18,452		5,271	219	2,688	
Union CarbideCorporation Whiting (Lake outlet)	46.3	3,929	682	630			
American Maize Products Hammond	10.3	3,750	12,424				
Inland Steel Company East Chicago (24N-1)	50.4		4,662	2,940			
U. S. Steel Gary (Lake discharge)	229.7		8,490	13,282			
Wolf Lake							
Lever Brothers Company Hammond	5.3	1,791	701	604			

Evaluation of these facilities shows that BOD was reduced by 30 percent, suspended solids by 50 percent and oil by 75 percent. On October 21, 1969, the Board approved plans for advanced waste treatment of the treated refinery effluent. The completion date for this facility is set for August 1, 1970.

(d) U. S. Gypsum Company, East Chicago. The Company has approval from the East Chicago Sanitary District to connect additional wastewater to the District's sewerage system. A new save-all recovery system is being installed in the shingle department to minimize loss of suspended solids. Effluent reports during 1969 showed increased suspended solids concentrations in the effluent.

(e) Steiner Tissue Division, Georgia-Pacific Corporation, Gary.

The waste treatment facilities and connection to the Gary Sanitary District sewerage system was completed during June, 1969. Wastewater (1.5 mgd having a BOD of 280 mg/l and suspended solids content of 500 mg/l) is now receiving secondary treatment at the Gary sewage treatment plant.

(f) Union Carbide Corporation, Whiting. Construction was completed on an equalization tank and sewer connection to the East Chicago Sanitary District sewerage system during December, 1968. This system has eliminated the discharge of certain wastewater streams that are a regular source of contaminants that were causing wide day-to-day fluctuations in effluent BOD, oil and threshold odor values. The Corporation continues to work on in-plant controls to minimize waste losses.

(g) Cities Service Oil Company, East Chicago. The Company completed all planned in-plant controls and treatment improvements planned for completion by December 31, 1968. The Company is continuing work on in-plant controls to minimize day-to-day variation in effluent quality. Plans are being established for collection and discharge of certain wastewater streams to the East Chicago Sanitary District sewerage system. On October 21, 1969, the Board approved a time schedule for construction of advanced wastewater treatment.

(h) Inland Steel Company, East Chicago. Construction was completed on the waste treatment facilities for the new 12-inch Merchant Mill during the first quarter of 1969. The Merchant Mill began operation during the third quarter of 1969. Construction is progressing rapidly on the terminal oil and solids removal facilities and all phases of the project are on schedule or ahead of schedule. The completion date of May 1, 1970 should be met with no difficulty and it is likely that the facilities can be completed earlier. All other waste treatment projects established relative to the conference have been completed.

In January, 1969, the Stream Pollution Control Board approved plans and specifications for expansion of the existing 80-inch Hot Strip Mill waste treatment plant in order to provide treatment of 2,080 gpm of wastewater from the No. 3 Cold Strip Mill which is under construction.

(i) Youngstown Sheet and Tube Company, East Chicago. Construction was completed during February, 1969 on waste treatment

facilities for the Buttweld Mill, and the terminal lagoon for the Hot Rolling Mills was completed during June of 1969. The facilities for the blast furnace clarification and water reuse system were completed by December 3[illegible], 1969. Construction is proceeding on schedule for the central treatment plant to serve the tin mills and cold reduced sheet mill scheduled for completion by June 30, 1970.

(j) U. S. Steel Corporation, Gary Tube Works, Gary.

The terminal oil skimming and solids removal facilities were completed during late 1968 which completed the construction program at this industry. Effluent reports and inspections by representatives of this office show that the effluent is satisfactory.

(k) U. S. Steel Corporation, Gary Sheet and Tin Mill, Gary. (now Gary Works West).

Construction on the sewers and lift stations to convey the Sheet Mill and Tin Mill wastewater to the Terminal Treatment Plant (6-Stand Tandem Cold Reduction Mill waste treatment facilities) were completed during June of 1969 and construction is proceeding toward a sewer and lift station to convey the effluent from the 80-inch Hot Strip Mill waste treatment facilities to the 84-inch Hot Strip Mill filtration facilities for additional treatment. This project is scheduled for completion by March 1, 1970.

(l) U. S. Steel Corporation, Gary Steel Works, Gary. (now Gary Works East).

Construction was completed during July, 1969 on oil separation for the steel making area. The discharge of the wastewater into the Blast Furnace settling basin was completed by December 31, 1969. The additional

settling basins for the Blast Furnace area, sewers, sumps, pumps, piping and settling and oil skimming basins for the Rolling Mills were completed by December 31, 1969.

(5) Lake Michigan.

(a) American Oil Company, Whiting. The Company completed construction of new ballast water oil separation facilities and improvements to the cooling water separator during late 1968. Effluent monitoring reports during 1969 show that substantial improvements have been made in effluent quality. BOD has been reduced by 50%, oil by 31%, and phenol by 36%. The Company is proceeding with preparations for construction of advanced wastewater treatment facilities to further treat the effluent. The advanced waste treatment facilities are scheduled for completion by December 31, 1970.

(b) American Maize Products Company, Hammond. The Company completed installation of six 50-hp mechanical aerators on the lagoon system during late 1968 and converted the anaerobic system to an aerobic system. The 95-hp of existing mechanical aerators were maintained in cell No. 2 and will be used for an aerobic digestion system for handling treatment sludges. Cell No. 4 of the lagoon system was cleaned and has been placed back in operation. Construction was completed on the clarifier during July to remove biological solids from the aerated lagoon effluent. The new system is now functioning as a modified activated sludge treatment system followed by a terminal lagoon. This system will substantially increase treatment efficiencies. The most recent report shows a 60 percent reduction in BOD over the

first 9 months of 1969.

(c) Other Industries. Three industries have cooling water discharges to Lake Michigan. These are Union Carbide, East Chicago; Inland Steel, East Chicago; and United States Steel, Gary Works.

(c) Combined and Storm Sewer Overflows. The following summarizes the major combined and/or storm water discharges to Indiana waters of the Conference area:

1. The City of East Chicago has 3 combined sewer pumping stations with discharge in excess of dry weather capacity to the Grand Calumet River and Indiana Harbor Canal.
2. The City of Gary has 7 combined sewer overflows with discharge in excess of dry weather capacity to the Grand Calumet River. It also has a separate storm sewer system with discharge to the Grand Calumet River.
3. The Town of Griffith has 1 combined sewer pumping station with discharge above dry weather capacity to the Little Calumet River.
4. The City of Hammond has 1 combined sewer pumping station with discharge in excess of dry weather flow to Lake Michigan, 4 to the Grand Calumet River, and 10 to the Little Calumet River (including 2 from the Munster area). Hammond also has two separate storm sewer systems with pump station discharges to Wolf Lake.

5. The Town of Highland has 2 combined sewer pumping stations with discharge in excess of dry weather capacity to the Little Calumet River. It also has a combined sewer overflow with discharge in excess of dry weather capacity to a tributary to the Little Calumet River.

6. The City of Whiting has a combined sewer system with gravity overflow at one outfall and a pumping station; both of these discharge to Lake Michigan during wet weather periods.

The Board has approved plans, submitted by the Hammond Sanitary District, for sewer separation and disinfection of Hammond's discharge to Lake Michigan. The City of East Chicago has a demonstration project under construction for control and disinfection of combined sewer overflow from approximately 1/3 of its area. Gary and Griffith have studies underway for improvements to control discharge from their combined sewer overflows.

The City of Whiting has been scheduled for a hearing by the Board relative to the requirement for control and disinfection of its discharge to Lake Michigan.

Figure 1 shows the general location of storm and combined sewer overflows in Indiana.

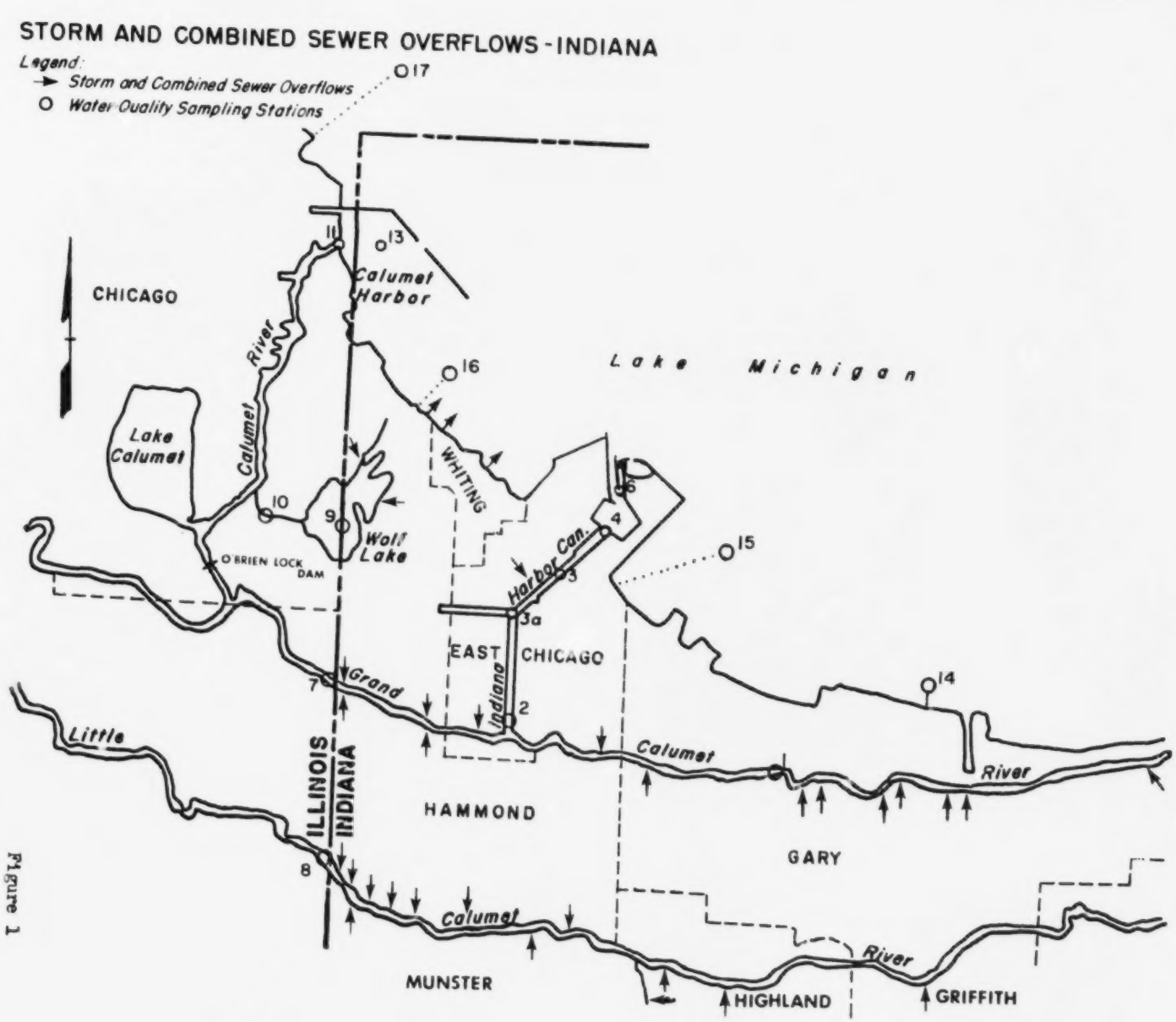

STORM AND COMBINED SEWER OVERFLOWS - INDIANA
Legend:
Storm and Combined Sewer Overflows
Water Quality Sampling Stations
CHICAGO
Calumet Harbor
Calumet River
Lake Michigan
Lake Calumet
WHITING
Wolf Lake
O'BRIEN LOCK DAM
Harbor Can.
EAST CHICAGO
Indiana
Grand
Little
Calumet
River
ILLINOIS
INDIANA
HAMMOND
GARY
MUNSTER
HIGHLAND
GRIFFITH
17
13
16
15
14
10
9
8
7
6
5
4
3
3a
2

Figure 1

Illinois-Metropolitan Sanitary District of Greater Chicago.

(a) Industrial Waste Discharges on Lake Side of O'Brien Locks.

The following Illinois companies were included in the proceedings of December 11-12, 1968 Illinois-Indiana Conference.

1. Allied Chemical Company
2. Bulk Terminal Company
3. Chicago Brick Company
4. Commonwealth Edison Company, Calumet Station
5. General Mills Corporation
6. Gulf Oil Company (Spencer Chemical, Cosden)
7. Swift and Company
8. United Chemical Company
9. Cargill Corporation
10. Catalin Corporation (Ashland Chemical)
11. Ford Motor Company
12. Interlake Steel Company
13. Wisconsin Steel Company
14. Republic Steel Company
15. United States Steel Company (South Works)

(1) Industrial Waste Discharges not in Compliance with Effluent Criteria.

The above companies are presently meeting State of Illinois effluent criteria with the following exceptions:

1. Cargill Corporation
2. Interlake Steel Company
3. Wisconsin Steel Company

4. Republic Steel Company

5. United States Steel (South Works)

(2) Enforcement Status of Companies not in Compliance with Effluent Criteria.

(a) Cargill Corporation. The Cargill Corporation consists of four separate divisions at the same general location.

1. Grain Elevator
2. Commodities Division
3. Vegetable Oil Division
4. Rogers Terminal

The Grain Elevator Division was in compliance by September 9, 1969. The company has stopped all discharge to the waterway from the Commodities and Vegetable Oil Divisions by plugging outfall pipes. Industrial waste treatment facilities are under construction for the Vegetable Oil Division. The Rogers Terminal Division has not provided adequate treatment for sanitary wastes from 7 to 70 employees, and a law suit has been filed.

(b) Interlake Steel Company (Chicago Plant). Interlake, on the lake side of the O'Brien Locks, has operations on both sides of the Calumet River. Facilities for pollution control in the Coke Plant area have been completed. A floating device has been installed in the private slip to retain any accidental spills of oil from this area. The blast furnace area presently discharges waste in violation of the State of Illinois effluent criteria. The company is constructing a complete recycle system for the blast furnace gas washer water and

the sinter plant effluent. Table 4 lists average monthly discharge from the Chicago Plant. Operation of the completed system should begin by February 28, 1970. The delay was caused by inadequate electrical supply. The demand for additional electricity was created by a design change which includes recycle of sinter plant waste not included in original proposal.

(c) Wisconsin Steel Company. The following Table compares waste discharge for first six months of 1968 with first six months of 1969, based on data furnished by the company. Only two

WISCONSIN STEEL COMPANY
POUNDS PER DAY - FIRST SIX MONTHS OF YEAR

	Suspended Solids	Phenols	Cyanides	Hexane Solubles	NH_3-N
1968	28,471	34.7	84.7	997	1542
1969	20,928	17.9	65.4	609	624

outfalls (#5 and #6) of an original thirteen outfalls in 1964 remain in service. Waste water discharged to the river has been reduced from 120 million gallons per day in 1964 to present average of 50 million gallons per day. The company completed proposed projects prior to the September 30, 1969 deadlines. Samples of the company's effluent taken October 3, 4, 5 & 6th, 1969 shows violations of suspended solids, phenol and cyanide criteria on each date.

(d) Republic Steel Company. The following Table compares waste discharge for six months of 1968 with first six months of 1969, based on data submitted by the company. Interim reduction

TABLE 4

INTERLAKE STEEL - CHICAGO
BLAST FURNACE AND SINTER PLANT
POUNDS PER DAY DISCHARGED
(BASED ON DATA FURNISHED BY COMPANY)

		JAN.	FEB.	MAR.	APR.	MAY	JUNE	JULY	AUG.	SEP.	OCT.	NOV.	DEC.	MONTHLY AVERAGE
Suspended Solids	1968					48,341	13,095	19,149	8,547	71,666	12,762	9,975	17,104	25,080
	1969	16,928	11,871	7,872	10,178	26,432	12,780							14,344
Hexane Solubles	1968					51,494	76,488	37,902	5,369	5,370	12,486	7,185	8,039	25,542
	1969	13,984	3,799	2,382	1,346	7,622	3,748							5,480
Cyanide	1968					49.3	26.9	39.1	21.3	45.1	47.8	16.8	42.0	36.0
	1969	33.1	25.2	31.8	39.5	37.8	84.9							42.1
Phenol	1968					64.9	70.9	103.9	73.4	80.3	99.6	85.9	2.15	72.6
	1969	49.44	110.03	158.35	29.45	19.5	13.1							63.3
NH_3-N	1968					932.2	873.2	981.1	1024.4	1112.9	942.5	1092.2	1088.3	1005.9
	1969	1170.5	978.8	1892.0	1039.7	766.1	598.8							1074.3

REPUBLIC STEEL COMPANY
POUNDS PER DAY - FIRST SIX MONTHS OF YEAR - CALUMET RIVER

	Suspended Solids	Phenols	Cyanides	Hexane Solubles
1968	48,740	47.2	177.7	5,946
1969	33,978	39.8	17.5	4,150

in concentrations of waste was accomplished by replacing a 12 inch mill with a new 14-inch mill having adequate treatment facilities. Low cyanide in 1969 was caused by shutdown of blast furnace from March 28, 1969 to May 20, 1969. Process water is now being recirculated in the Blast Furnace-Coke Plant, Open Hearths, Bar Mill Reheat Furnace and Blooming Mill area.

Negotiations with the company resulted in reducing the proposed construction schedule by a total of 20 months. (September 1, 1972 to December 31, 1970). The Sanitary District is not authorized to approve any compliance date beyond September 30, 1969, the date established by the State of Illinois for compliance with waterway effluent criteria. The company failed to meet the September 30, 1969 compliance date. The company is constructing treatment facilities which they expect to complete by December 31, 1970.

(e) United States Steel Company - South Works, Calumet Harbor.

The United States Steel Company-South Works is the only Illinois Company discharging directly into the Calumet Harbor. The following Table compares the company's waste discharge to the Harbor in pounds per day for the first six months of 1968 with the first six months of 1969. All values included are based on analyses of monthly 8-hour

composite samples submitted by the company. The Table shows reduction in pounds per day for all waste discharged directly to the Calumet Harbor with the exception of Phenols and Ammonia Nitrogen.

UNITED STATES STEEL COMPANY - SOUTH WORKS, CALUMET HARBOR
POUNDS PER DAY - FIRST SIX MONTHS OF YEAR - CALUMET HARBOR

	Suspended Solids	Phenols	Cyanide	Hexane Solubles	Ammonia Nitrogen
1968	104,323	37.8	657.1	41,862	1,003
1969	57,014	82.8	134.2	23,072	1,432

The following Table compares the company's waste discharge to the Calumet River in pounds per day for the first six months of 1968 with the first six months of 1969. The Table shows reduction in pounds per day for all waste discharged into the Calumet River.

UNITED STATES STEEL COMPANY - SOUTH WORKS, CALUMET HARBOR
POUNDS PER DAY - FIRST SIX MONTHS OF YEAR - CALUMET RIVER

	Suspended Solids	Phenols	Cyanide	Hexane Solubles	Ammonia
1968	237,324	58.6	899.9	5,667	1246
1969	12,745	3.4	17.4	2,368	169

The following Table of total plant discharge shows that the total waste discharge in pounds per day for all parameters has been reduced.

UNITED STATES STEEL COMPANY - SOUTH WORKS, CALUMET HARBOR
POUNDS PER DAY - FIRST SIX MONTHS OF YEAR
TOTAL PLANT DISCHARGE - RIVER AND HARBOR

	Suspended Solids	Phenols	Cyanide	Hexane Solubles	Ammonia
1968	341,647	96.4	1557.0	47,529	2249
1969	69,759	86.2	151.2	24,440	1600

The company is proceeding with construction of a Central Treatment Plant and Blast Furnace Waste Water recycle system. Construction is proceeding on schedule for completion December 31, 1970.

(b) Industrial Waste Discharges on River Side of O'Brien Locks - Interlake Steel Company - Riverdale Plant.

Major waste treatment projects include an acid neutralization system and high rate filter system. The acid neutralization system, including a new clarifier, was completed and placed in operation October 21, 1969. The filter system is not proceeding in accordance with the approved construction schedule. Company now proposes completion by February 28, 1970. Table 5 includes the monthly discharge of pollutants from Riverdale Plant in pounds per day.

(c) Combined Sewer Overflows. During storm periods, a combination of storm water and untreated municipal wastes may be discharged to the Calumet River from the 95th Street pumping station of the Metropolitan Sanitary District of Greater Chicago. The annual quantities discharged at the 95th Street pumping station from 1960 through August 1969 are shown in Table 6 . These infrequent discharges have been chlorinated since 1967. Figure 2 shows the location of combined sewer overflows.

Illinois. The only direct discharges within the jurisdiction of the Illinois Sanitary Water Board in the Calumet Conference Area are located in the village of Lansing, Illinois, with discharges to the Little Calumet River. These are the chlorinated effluent from the secondary waste treatment plant at Lansing, and the discharge from the Burnham Avenue storm water pumping station.

TABLE 5

INTERLAKE STEEL - CHICAGO
RIVERDALE PLANT
POUNDS PER DAY DISCHARGED
(Based on data furnished by Company)

		Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Monthly Avg.
Susp. Solids	1968					28,042	31,094	27,574	14,342	16,650	30,927	56,701		29,335
	1969	26,892	36,807	33,831	38,843	24,804	26,085							30,208
Hexane Solubles	1968					4,435	3,509	12,427	5,523	13,058	5,658	7,480		8,878
	1969	13,438	3,517	497	4,230	3,234	4,897							6,548
Cyanide	1968					6.5	5.3	2.5	2.3	2.3	2.7	2.6		3.5
	1969	3.8	2.6	6.7	2.1	2.0	3.1							3.4
Phenol	1968					5.68	5.03	8.30	2.89	4.08	4.23	3.15		4.9
	1969	8.4	33.6	9.7	7.3	5.3	5.0							12.6
NH_3-N	1968					405	225	229	2.6	91	61	23		176.6
	1969	102.3	682.6	705.2	385.4	877.1	1773.8							754.4

TABLE 6

MUNICIPAL WASTE LOAD - LAKE SIDE OF O'BRIEN LOCKS

METROPOLITAN SANITARY DISTRICT-95TH STREET PUMPING STATION

Precipitation Normal 33" Per Year	Year	Number of Events	Hours Duration Hrs:Min.	(MG) Flow	Average Plant Raw B.O.D. mg/l	B.O.D. Spilled Pounds Per Year
26.2	1960	14	36:32	314.2	102	267,284
37.9	1961	13	26:05	250.1	113	235,699
19.88	1962	5	9:40	80.6	124	83,353
27.51	1963	11	47:09	443.8	138	510,778
26.83	1964	6	6:52	24.0	124	24,820
39.6	1965	7	5:37	40.1	110	36,748
31.03	1966	64	1065:11	1772.4	136	2,010,327*
38.54	1967	5	7:54	200.7	132	220,447
29.20	1968	2	7:06	124.3	131	135,803
Thru 8/31 28.19	1969	Thru 8/26 2	1:05	11.0	130	11,926

*1966 excessive flow caused by repairs to sewer and sewer control facilities.

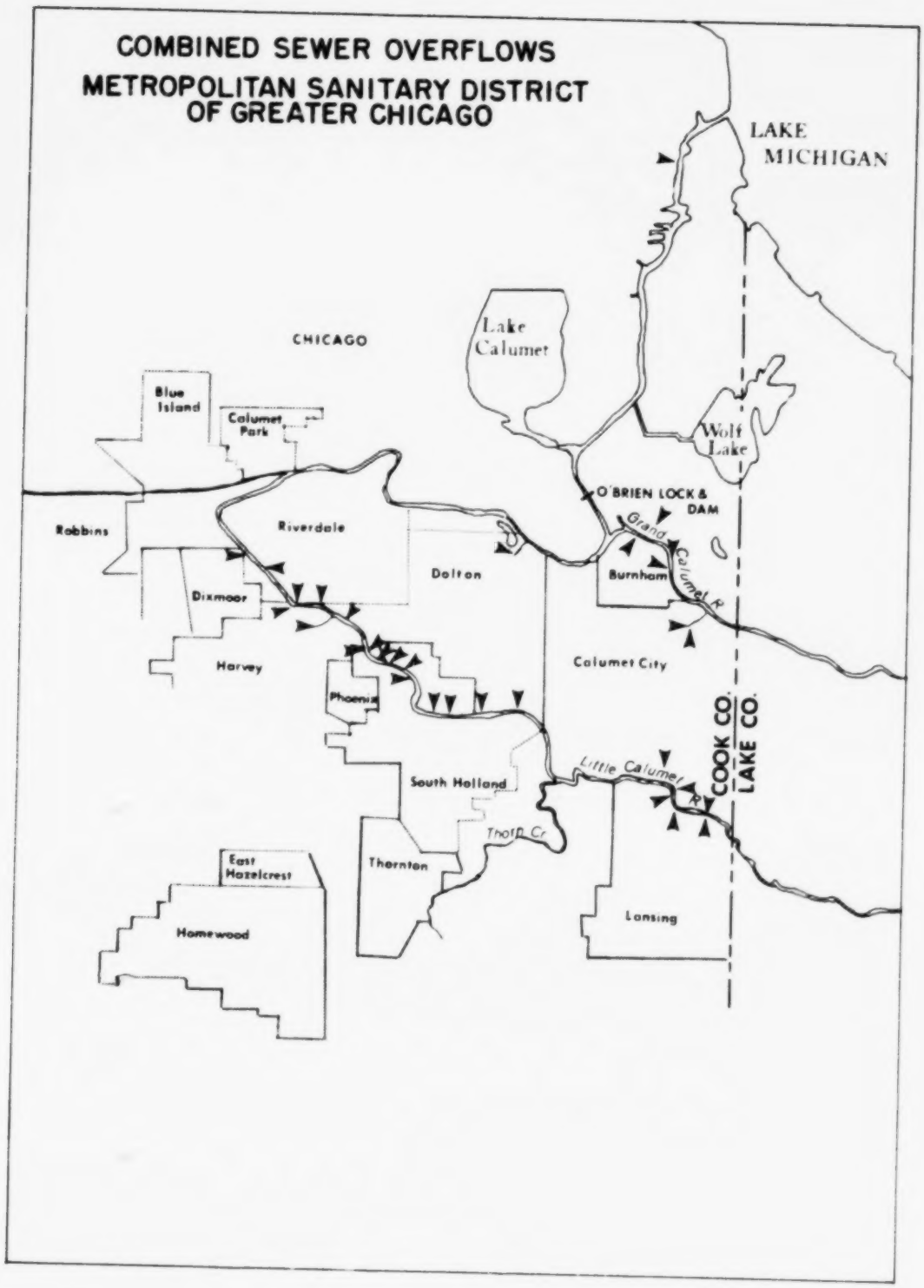

COMBINED SEWER OVERFLOWS
METROPOLITAN SANITARY DISTRICT
OF GREATER CHICAGO
LAKE
MICHIGAN
CHICAGO
Lake
Calumet
Blue
Island
Calumet
Park
Wolf
Lake
O'BRIEN LOCK &
DAM
Robbins
Riverdale
Grand Calumet R.
Dolton
Burnham
Dixmoor
Harvey
Calumet City
Phoenix
COOK CO.
LAKE CO.
South Holland
Little Calumet R.
Thorn Cr.
East
Hazelcrest
Thornton
Homewood
Lansing

Figure 2

V. PRESENT WATER QUALITY CRITERIA

The present water quality criteria applicable to the Calumet Area and Lower Lake Michigan was developed by a technical committee of the Calumet Area Enforcement Conference. The committee consisted of one representative of each of the four regulatory agencies (the States of Illinois and Indiana, the Metropolitan Sanitary District of Greater Chicago, and the Federal government), two representatives of industry (U. S. Steel Corporation and American Oil Company), and one each of the City of Chicago Department of Water and Sewers and the U. S. Department of the Interior.

The technical committee developed recommended criteria for (a) Open Water, (b) Inner Harbor Basins, (c) Shore Water, (d) Little Calumet River, (e) Grand Calumet River, and (f) Wolf Lake. The criteria were then adopted by the States of Illinois and Indiana as the water quality criteria applicable to portions of the Calumet Area and Lower Lake Michigan located in each State. These criteria are published in the report of the technical committee, "Water Quality Criteria, Calumet Area - Lower Lake Michigan," and as rules and regulations of the Illinois Sanitary Water Board and the Indiana Stream Pollution Control Board. The water quality criteria are not repeated here in detail. Instead, the applicable water quality criteria are cited at each water quality monitoring station when they are pertinent to the discussion in the section on "Present Water Quality."

VI. PRESENT WATER QUALITY

Station 1 - Grand Calumet River at Pennsylvania Railroad Bridge.

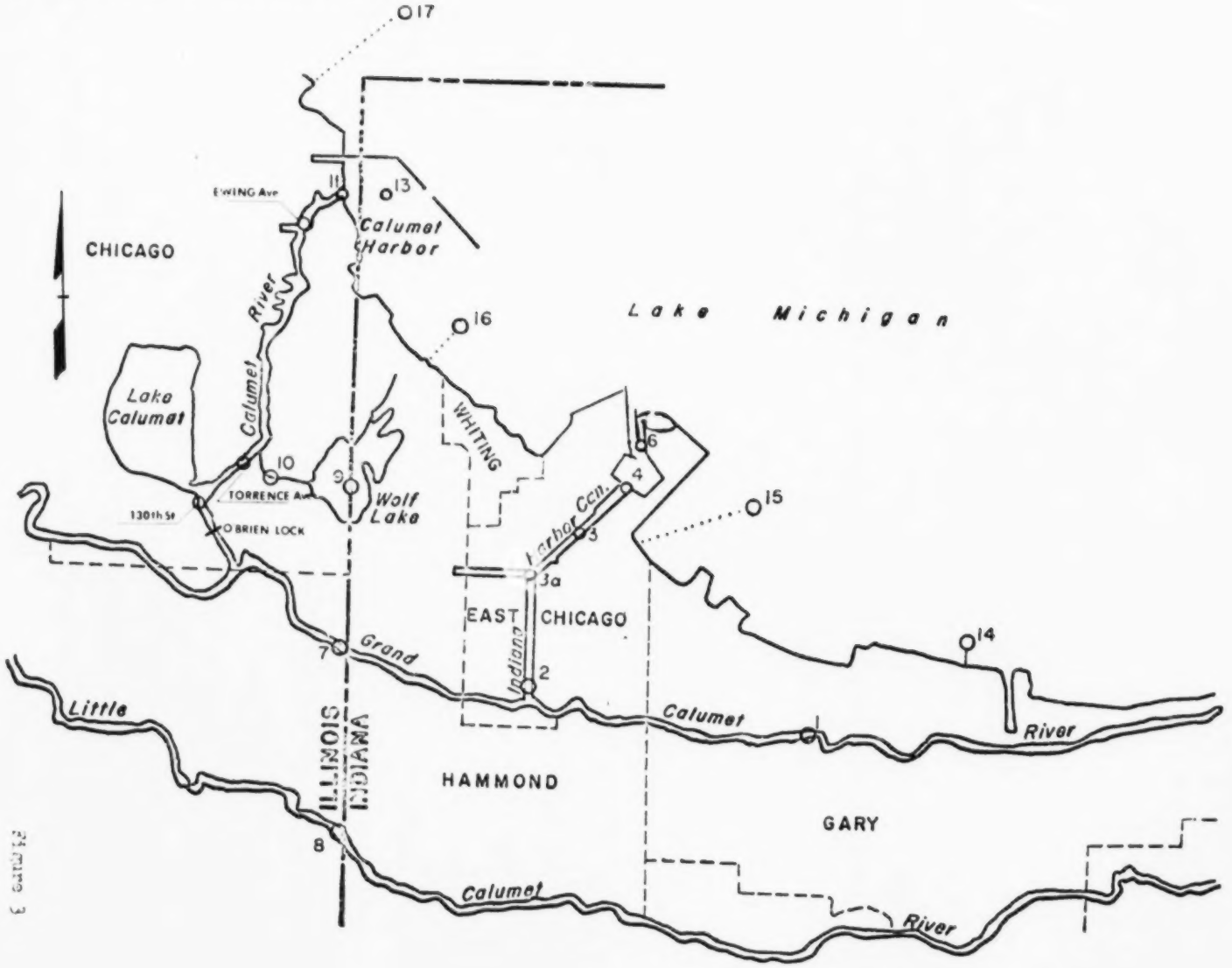
Station 1 is located about two miles downstream from the U. S. Steel Corporation's complex in Gary, Indiana (Figure 3). Almost all of the flow is the industrial waste effluent which in 1968 averaged 830 cfs. Combined sewer overflows in Gary contribute flow during wet weather periods; however, some additional wet weather flows are now being intercepted and treated at the Gary Sanitary District plant.

Review of analyses of samples indicates general improvement in the past four years in terms of coliforms, fecal streptococci, DO, ammonia nitrogen, and phenols, and a significant improvement in pH and sulfates.

Installation of deep well disposal for acid wastes disposal and interim improvements in wastewater treatment at U. S. Steel are responsible for improvements. Further improvements in water quality will be noted with completion of treatment facilities by U. S. Steel in 1970. However, satisfactory conditions will not be maintained at all times until treatment and/or control of storm and combined sewer overflows and surface runoff is provided.

This station is not a control point for established criteria; however, water quality at this station is not satisfactory in terms of the minimum conditions applicable to all waters at all places and at all times. In addition, improvement is required to meet criteria at downstream control points. The stream is still discolored by iron wastes, and solids settle out to cause objectionable deposits. Floating

LOCATION MAP - STATIONS 1 thru 17



materials, including oil, are unsightly and deleterious. A summary of the yearly data is shown in Table 7 and a summary evaluation of trends for numerical parameters is shown in Table 8.

Station 2 - Indiana Harbor Canal at 151st Street. Station 2 is located immediately downstream from the point where the east and west portions of the Grand Calumet converge at the upper end of the Indiana Harbor Canal. The flow at this point, which is around 900 cfs during dry weather, includes sewage treatment plant effluent from East Chicago and Gary, the flow described for Station 1, other industrial waste flows, and overflows from storm and combined sewers. At times part of the flow from the Hammond Sanitary District sewage treatment plant may be included; however, this is not considered a significant contribution.

A review of the analyses of samples at this station indicates an improvement in total coliform, fecal streptococci, pH, DO, ammonia nitrogen phenol, and sulfates. Most other parameters did not indicate significant changes in water quality for the past four years.

East Chicago has accepted wastewater from industry. Construction has been started on facilities to provide better interception and treatment. The completion of terminal treatment facilities by U. S. Steel Corporation and improvements at the East Chicago Sanitary District plant should improve water quality conditions. However, satisfactory conditions during dry weather periods will not be attained until the East Chicago Sanitary District improves effluent quality by increased reductions in terms of coliform, BOD, suspended solids, ammonia nitrogen, and phenols, and provides effective effluent disinfection. Satisfactory

TABLE 7

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 1 GRAND CALUMET RIVER AT PENNSYLVANIA RAILROAD BRIDGE

Parameter	July - Dec 1965			Jan - Dec 1966			Jan - Dec 1967			Jan - Dec 1968			Jan - June 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	31	12	22	32	10	20	28	9	20	30	9	22	26	7	16
Tot.Coli.MPN/100ml	1940M	5M	227M	2100M	100	40M	350M	1.5M	23M	450M	250	26M	35M	200	4.7M
Fec.Strep "	29M	70	2.5M	4.3M	10	410	5.0M	10	650	2.4M	20	230	2.5M	5	290
Fec.Coli. "	-	-	-	71M	10	6.7M	73M	100	5.7M	60M	30	3.9M	10M	10	1100
pH	7.5	4.1	-	8.0	5.6	-	8.6	6.0	-	7.8	6.0	-	7.7	6.8	-
DO mg/l	8.7	1.1	4.6	9.3	1.5	5.4	8.1	0.1	5.1	8.6	1.4	6.2	9.6	5.6	7.6
BOD "	17.3	5.7	10.1	16.0	2.4	8.3	12.0	5.1	7.6	26.0	0.3	7.7	15	4.4	9.4
COD "	152	7.9	42	55	14	31	114	14	41	61	16	34	1051	24	34*
Chlorides "	-	-	-	40	10	19	41	12	21	42	10	21	30	20	23
Sulfate "	186	32	60	200	47	60	235	22	59	68	29	43	64	20	35
NH_3-N "	3.7	0.87	1.54	4.4	0.88	2.27	4.9	1.0	1.76	2.0	0.98	1.52	2.8	0.9	1.50
NO_2-NO_3-N "	3.7	0.32	0.90	10.0	0.09	0.71	1.2	0.09	0.37	0.65	0.20	0.39	0.55	0.16	0.38
Org.Nitrogen "	3.7	0.06	1.10	1.2	2.0	0.44	1.6	0.8	0.57	0.90	0	0.46	0.8	0.30	0.57
Tot.Phos. "	-	-	-	-	-	-	0.36	0.11	0.190	1.06	0.05	0.205	0.703	0.05	0.20
Sol.Phos. "	-	-	-	-	-	-	0.14	0.0	0.033	0.22	0.0	0.041	-	-	-
Dis.Iron "	-	-	-	-	-	-	-	-	-	3.4	0.0	0.42	5.45	0.0	0.60*
Tot.Iron "	29	2.2	8.8	40	2.5	12.3	109	5.4	36.6	51	6.5	17.7	80.5	6.5	15.5
Phenol ug/l	392	10	79	320	7.6	87	601	1.0	147	333	2.0	56	119	26	51
Oil&Grease mg/l	-	-	-	-	-	-	22	1.8	10.5	27	1.0	6.2	257	2.0	6.4*
Cyanide "	0.80	0.0	0.12	0.65	0.0	0.28	0.69	0.07	0.35	1.2	0.12	0.46	1.3	0.06	0.36
Sus.Solids "	130	10	47	195	29	71	842	12	111	104	5.5	51	250	21	68
Dis.Solids "	364	170	226	380	109	257	458	112	244	258	203	230	286	212	240
Cnductvy, umho/cm	-	-	-	765	308	395	525	320	375	400	310	357	470	305	371
MBAS mg/l	-	-	-	0.28	0.07	0.14	0.34	0.09	0.16	0.23	0.05	0.12	0.65	0.09	0.22
No. of Samples	26			52			44			38			29		
	(Susp.Solids 18 Dis. Solids 18)			(Chlorides 45)						(Chlorides 12 All Nitrogens 12 Sol. Phos. 7 MBAS 12)			(Chlorides 6 All Nitrogens 6 MBAS 6)		

*Excluded maximum of 1051 of COD, 5.45 mg/l of iron and 257 mg/l oil from average.

( ) Number of samples when number differed from that shown for rest of parameters.

TABLE 8
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 1 GRAND CALUMET RIVER AT PENNSYLVANIA RAILROAD BRIDGE
July 1965 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliform MPN/100 ml	X		
Fecal Streptococci MPN/100 ml	X		
Fecal Coliform MPN/100 ml	X		
pH	X		
DO mg/l	X		
BOD mg/l			X
COD mg/l			X
Chlorides mg/l		X	
Sulfate mg/l	X		
NH_3-N mg/l	X		
NO_2NO_3N mg/l			X
Organic N mg/l			X
Total Phosphorus mg/l			X
Soluble Phosphorus mg/l		X	
Dissolved Iron mg/l			X
Total Iron mg/l	X		
Phenol ug/l	X		
Oil and Grease mg/l			X
Cyanide mg/l		X	
Suspended Solids mg/l			X
Dissolved Solids mg/l			X
Conductivity umho/cm			X
MBAS mg/l			X

conditions will not be maintained at all times until the municipalities provide treatment and/or control of storm and combined sewer overflows and industries provide control and/or treatment of contaminated surface water runoff.

This station is not a control point for established criteria, however, water quality at this station is not satisfactory in terms of minimum conditions applicable to all waters at all places and at all times. In addition, major improvement is required to meet criteria at the downstream control point. The stream is discolored and solids settle out to cause objectionable deposits. Floating materials, including oil, are unsightly and deleterious. A summary of the yearly data is shown in Table 9 and a summary evaluation of trends for numerical parameters is shown in Table 10.

Station 3 - Indiana Harbor Canal at Dickey Road. Station 3 is downstream from the Lake George Branch of the Indiana Harbor Canal and receives wastes from refineries on this Branch in addition to wastes from the main branch of the canal. It is upstream from waste effluents from Youngstown Sheet and Tube Company and Inland Steel Company, but may at times be affected by these wastes due to hydraulic conditions in the canal.

A review of FWPCA sample analyses show there has been little change in water quality at the Dickey Road station in the past four years. Coliform, fecal streptococci, pH, phenol, and sulfates show improvement. DO shows a slight downward trend; however, most other parameters are relatively unchanged. As mentioned previously, East Chicago must complete its sewage works project to improve these conditions.

TABLE 9

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 2 INDIANA HARBOR CANAL - 151ST ST. BRIDGE

Parameters	July-Dec 1965			Jan-Dec 1966			Jan-Dec 1967			Jan-Dec 1968			Jan-June 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	22	11	16	31	10	19	28	8	19	31	10	21	25	8	16
Tot.Coli. MPN/100ml	4300M	10M	1140M	360M	4M	80M	1500M	5.3M	175M	1500M	1.3M	175M	110M	800	20.5M
Fec.Strep. "	2M	100	4.1M	19M	50	2.5M	90M	170	4.6M	1.3M	100	1.6M	9M	10	1M
Fec.Coli. "	-	-	-	300M	500	43.1M	900M	1050	66.2M	200M	450	29.2M	15M	100	3.1M
pH	7.3	6.1	-	7.9	6.3	-	8.2	6.4	-	8.6	6.8	-	8.0	6.6	7.2
D.O. mg/l	7.7	2.1	4.4	8.1	0.2	4.4	7.7	0.2	4.3	8.1	1.1	4.8	9.4	5.5	6.5
BOD "	17.0	4.4	9.0	22	4.9	9.0	16.0	3.1	9.0	28.0	1.3	9.0	14.2	5.1	9.1
COD "	148	7.7	42	60	17	32	170	18	59	154	14	41	64	12	37
Chlorides "	-	-	-	44	16	27	60	20	30	60	16	30	51	19	30
Sulfate "	128	50	70	138	50	77	125	45	69	97	45	71	87	29	58
NH3-N "	4.0	0.27	1.45	9.1	1.0	5.11	7.9	2.3	5.65	5.6	2.2	3.16	5.7	2.3	3.1
NO_2-NO_3-N "	2.2	0.23	1.13	1.7	0.08	0.75	1.4	0.11	0.43	3.0	0.37	1.16	1.10	0.03	0.59
Org.Nitrogen "	4.3	0.30	1.17	3.6	0.3	0.86	2.6	0.2	0.89	1.6	0.39	0.76	3.00	0.4	1.2
Tot.Phos. "	-	-	-	-	-	-	0.55	0.30	0.404	1.36	0.140	0.553	.803	0.184	0.49
Sol.Phos. "	-	-	-	-	-	-	0.40	0.07	0.196	0.49	0.10	0.195	-	-	-
Dis.Iron "	-	-	-	-	-	-	-	-	-	1.0	0.28	0.57	4.3	0.11	0.48
Tot.Iron "	15	0.76	4.3	29	1.6	6.9	41	2	10.2	20.0	3.7	14.7	40.0	6.4	13.7
Phenol ug/l	508	9	71	263	12	77	6150*	6.8	95	1400	15	150	105	21	55
Oil&Grease mg/l	-	-	-	-	-	-	9.8	1.2	3.4	28	0.6	5.8	12	2.0	5.4
Cyanide "	0.53	0.0	0.11	0.44	0.0	0.18	0.19	0.15	0.19	-	-	-	-	-	-
Susp.Solids "	136	10	41	162	21	67	239	19	72	140	0.64	54	112	29	53
Dis.solids "	640	240	297	375	160	276	549	209	280	554	221	277	325	230	278
Conductvy umho/cm	-	-	-	550	385	463	590	380	452	540	368	438	490	360	446
MBAS mg/l	-	-	-	0.39	0.13	0.23	0.45	0.10	0.26	0.93	0.09	0.25	0.29	0.15	0.20
No. of Samples:	16			52			44			58			25		
				Chlorides 41						Chlorides 12			Chlorides 6		
										All Nitrogens 12			All Nitrogens 6		
										Sol. Phos. 7			MBAS 6		
										MBAS 12					

*Excluded from mean.

( ) Number of samples when number differed from that shown for rest of parameters.

TABLE 10
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 2 INDIANA HARBOR CANAL - 151st ST. BRIDGE
July 1965 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliform MPN/100 ml	X		
Fecal Streptococci MPN/100 ml	X		
Fecal Coliform MPN/100 ml	X		
pH	X		
DO mg/l	X		
BOD mg/l			X
COD mg/l			X
Chlorides mg/l			X
Sulfate mg/l	X		
NH_3-N mg/l	X		
NO_2NO_3N mg/l		X	
Organic N mg/l			X
Total Phosphorus mg/l			X
Soluble Phosphorus mg/l			X
Dissolved Iron mg/l			X
Total Iron mg/l			X
Phenol ug/l	X		
Oil and Grease mg/l		X	
Cyanide mg/l			X
Suspended Solids mg/l	X		
Dissolved Solids mg/l			X
Conductivity umho/cm			X
MBAS mg/l			X

The dry weather discharge of wastes from the East Chicago Sanitary District sewers and the discharge of wastes from miscellaneous outfalls must be abated. The quality of effluent from the District treatment plant must be improved. Satisfactory conditions will not be maintained at all times until the municipalities provide treatment and/or control of storm and combined sewer overflows and industries complete current programs and provide control and/or treatment of contaminated surface water runoff.

This station is not a control point for established criteria, however, water quality at this station is not satisfactory in terms of minimum conditions applicable to all waters at all places and all times. In addition, major improvement is required to meet criteria at the downstream control point. The stream is discolored and solids settle out to cause objectionable deposits. Floating materials, including oil, are unsightly and deleterious. A summary of the yearly data is shown in Table 11 and a summary evaluation of trends for numerical parameters is shown in Table 12.

Stations 4 and 6 - Indiana Harbor. Indiana Harbor has been sampled at two points. Station 4 is located at the mouth of the Indiana Harbor Canal, upstream of the Inland Steel and Youngstown Sheet and Tube turning basin. Station 6 is located at the east breakwall inner light which is downstream from all of the industrial discharges to the harbor. Station 6 is the control point for Indiana Regulations SPC 7 which is the criteria for the Indiana Harbor Canal. A third station, station 5, was located at mid channel opposite station 6.

Parameter	July-Dec 1965			Jan-Dec 1966			Jan-Dec 1967			[illegible]			[illegible]		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp.°C	[illegible]														
Tot.Coli.MPN/100ml	[illegible]														
Fec.Strep. "	[illegible]														
Fec.Coli. "	[illegible]														
DO	[illegible]														
pH	mg/l	[illegible]													
BOD	"	[illegible]													
CO2	"	[illegible]													
Chlorides	"	[illegible]													
Sulfate	"	[illegible]													
Nes-N	"	[illegible]													
NH3-N	"	[illegible]													
Org.Nitrogen	"	[illegible]													
Tot.Phos.	"	[illegible]													
Sol.Phos.	"	[illegible]													
Dis.Iron	"	[illegible]													
Total Iron	"	[illegible]													
Phenol	µg/l	[illegible]													
Dis.Grease	mg/l	[illegible]													
Vanide	"	[illegible]													
Susp.Solids	"	[illegible]													
Dis.Solids	"	[illegible]													
Conductiv	µmho/cm	[illegible]													
MBAS	mg/l	[illegible]													
No. of Samples		30			52			44			38			20	
		Susp. Solids 19 Dis.Solids 18)			Chlorides 33)						Chlorides 1. All Nitrogens 12 Tot. Phos. 7 MBAS 12)			Chlorides 6 All nitro- gens 6 MBAS 6		

*Exclusive of maximum value of 1.28 for dissolved iron.

( )Number of samples when number differed from that shown for rest of parameters.

TABLE 12
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 3 INDIANA HARBOR CANAL AT DICKEY ROAD BRIDGE
July 1965 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliform MPN/100 ml	X		
Fecal Streptococci MPN/100 ml	X		
Fecal Coliform MPN/100 ml	X		
pH	X		
DO mg/l		X	
BOD mg/l			X
COD mg/l		X	
Chlorides mg/l		X	
Sulfate mg/l	X		
NH_3-N mg/l			X
NO_2NO_3N mg/l			X
Organic N mg/l			X
Total Phosphorus mg/l		X	
Soluble Phosphorus mg/l			X
Dissolved Iron mg/l			X
Total Iron mg/l			X
Phenol ug/l	X		
Oil and Grease mg/l			X
Cyanide mg/l			X
Suspended Solids mg/l			X
Dissolved Solids mg/l			X
Conductivity umho/cm			X
MBAS mg/l			X

A comparison of data between station 5 and station 6 revealed no essential difference in water quality between the two points. Therefore sampling of station 5 was discontinued during July 1967. The average dry weather flow past station 6 to Lake Michigan is estimated to be 2700 cfs, but under certain wind and lake level conditions, lake water is backed up into the harbor creating the effect of an estuary. The lake water does not mix with the harbor water, but forms a wedge which extends in below the harbor water. This separation is caused by the temperature differential between harbor and lake water. The warmer harbor water stays above the cold lake water. The surface of the wedge varies from 8 to 12 feet in depth at station 6 and between 18 and 20 feet at station 4.

The chemical results show that since 1965 some pollutants have been reduced by actions taken by the industries in the area. However, Tables 13 and 14 show that bacterial counts in the harbor do not meet the criteria and have not improved since 1965. They show a similar lack of improvement in BOD, ammonia, phosphorus, MBAS and dissolved solids. This indicates that the domestic waste load to the harbor has not been reduced in spite of efforts by the industries to divert sanitary wastes from the canal and harbor. The reason for this lack of improvement is the existence of heavily loaded combined sewers which frequently discharge to the canal.

The level of industrial pollution in the harbor remains high. Concentrations of cyanide and COD have not been reduced and oil has been reported on the surface on 23 of 24 samplings between

TABLE 13

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION NO. 4 INDIANA HARBOR CANAL AT PIERHEAD LIGHTS

Parameter	Aug.-Dec. 1965			Apr.-Oct. 1966			May-Dec. 1967			Feb.-Dec. 1968			Jan.-Jun. 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	26	11	21	29	12	22	26	14	19	29	10	20	22	10	16
Tot.Coli. No./100ml	830m	57m	212m	240m	5m	81m	1300m	8m	290m	1000m	3500	280m	410m	3m	77m
Fec.Strep "	1000	30	430	1700	10	350	1300	90	400	3100	30	470	2600	10	480
Fec.Coli. "	-	-	-	50m	250	11m	360m	3m	67m	50m	100	12m	9100	400	2650
pH	7.3	6.8	-	8.0	6.8	-	8.0	6.0	-	8.2	7.3	6.5	7.7	7.0	7.3
DO mg/l	6.6	2.4	3.8	7.2	0.9	3.6	5.4	1.6	3.8	7.5	2.3	4.9	8.9	2.8	4.8
BOD mg/l	9.1	2.8	4.7	7.0	2.4	3.9	5.2	1.8	4.0	5.9	2.1	3.9	6.8	3.5	5.2
COD mg/l	126	0	37	58	6	17	29	8.5	15	46	1.5	19	49	4.1	21
Chlorides mg/l	-	-	-	30	10	22	35	13	25	36	19	24(9)	38	22	28(6)
Sulfate mg/l	62	34	52	84	23	58	90	24	54	67	25	44	61	22	41
NH_3-N mg/l	1.9	.75	1.2	5.6	0.8	2.6	4.7	.95	2.4	3.0	1.2	2.0(9)	3.5	2.2	2.8(6)
NO_2+NO_3-N mg/l	.74	.29	.42	.80	.11	.37	.79	.09	.34	.85	.3	.55(9)	0.4	0.1	0.3(6)
Org.N mg/l	1.7	.30	.94	1.4	0	0.5	1.9	0.1	1.0	0.5	0.1	0.3	0.8	0.1	0.5
Tot. P mg/l	.095	.026	.059	.147	.029	.075	.350	.072	.157	.264	.007	.157	.312	.052	.158
Sol. P mg/l	.033	.010	.020	.036	.013	.020	.082	.016	.042	.089	.039	.058(4)	-	-	-
Dis.Iron mg/l	-	-	-	-	-	-	-	-	-	.40	0	.14	.49	.05	.20
Tot.Iron mg/l	5.0	2.0	2.9	44	1.2	4.4	5.4	1.2	2.8	3.6	11	1.9	3.25	1.07	2.16
Phenol ug/l	42	5.5	16	84	5	18	41	3	19	55	3	11	48	5	14
Oil & Grease mg/l	-	-	-	-	-	-	22	1.3	8.6	5.9	0	2.4	7.1	1.0	3.2
Cyanide mg/l	.01	0	0	.25	0	.06	-	-	-	-	-	-	-	-	-
Susp.Solids mg/l	107	11	31	81	7	19	73	3	19	28	5	15	61	6	18
Dis.Solids mg/l	253	215	238	305	130	232	295	178	284	318	144	241	285	123	244
Conductivity umho/cm	-	-	-	460	300	392	520	325	413	460	320	378	480	405	305
MBAS mg/l	-	-	-	.25	.07	.17	.93	.09	.26	.43	.11	.19(9)	.32	.15	.23(6)
No. of Samples	7			27			20			26			17		

( ) Number of samples when number differed from that shown for rest of parameters

TABLE 14

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 6 INDIANA HARBOR AT EAST BREAKWALL INNER LIGHT

Parameter	Dec 1965			Jan-Dec 1966			Jan-Dec 1967			Jan-Dec 1968			Jan-June 1969			Criteria*		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	10	9	9	29	6	16	24	5	16	27	9	18.6	21	6	13	32.2	-	-
Total Coli./No./100ml	22M	1M	11M	350M	1M	38M	510M	300	55M	800M	400	122M	180M	1800	32M	5000	-	2000
Fec.Strep. "	530	510	580	1600	10	180	875	20	200	900	10	200	1600	10	260	100	-	-
Fec.Coli. "	-	-	-	23M	10	2900	97M	100	12M	110M	40	9500	6300	300	1700	-	-	-
pH	6.9	6.7	6.8	8.0	6.6	-	8.0	6.0	-	8.2	6.5	7.4	8.5	7.0	7.4	9.0	7.0	7.5-8.5
DO mg/l	7.2	7.0	7.5	8.0	1.1	5.9	9.1	0.1	7.1	9.9	1.8	5.8	10.0	3.9	6.8	-	2.0	4.0
BOD "	3.4	2.9	3.1	13	1.2	3.7	8.8	1.5	4.5	11	1.6	5.0	9.1	2.8	4.7	-	-	-
COD "	131	13	87	72	4	16	54	6	11	220	1.5	22	100	2	22	-	-	-
Chlorides "	-	-	-	33	9	21	40	11	24	39	15	23(1)	34	21	29(1)	35	-	25
Sulfate "	68	56	64	37	22	31	70	11	45	61	21	37	46	15	32	75	-	60
NH3-N "	1.7	1.5	1.6	2.8	.19	1.7	3.1	.34	1.7	2.5	1.1	1.5(1)	2.9	1.1	2.2(1)	1.5	-	1.0
NO2-NO3-N "	.60	.30	.46	.80	.10	.45	.53	.09	.32	0.8	.24	.45(1)	0.4	0.1	0.3(1)	-	-	-
Org.Nitrogen "	0.5	0.2	0.3	2.7	0	0.6	6.4	0	1.2	0.6	0.2	0.4(1)	0.6	0.2	0.4(1)	-	-	-
Total Phos. "	.120	.026	.062	.456	.026	.065	8.15	.035	.244	.491	.025	.136	2.19	.06	.25	.033	-	.016
Sol.Phos. "	.059	.033	.036	.098	.003	.023	5.26	.006	.096	.095	.006	.024(1)	-	-	-	-	-	-
Dis.Iron "	-	-	-	-	-	-	-	-	-	.38	0	.13	.45	.06	.17	0.30	-	0.15
Total Iron "	3.1	1.5	2.3	15	1.1	3.3	7.7	.76	2.8	9.0	.93	2.18	7.8	.94	2.5	-	-	-
Phenol ug/l	24	18	21	422	1.4	21	675	0	53	33	0	7.4	54	7	15	10	-	5
Oil&Grease mg/l	-	-	-	-	-	-	3.3	0.5	1.4	13	0	2.7	15.8	0	4.5	-	-	-
Cyanide "	0.18	0	0.06	.35	0	.08	.36	0	.10	.25	0	.06	.79	0	.15	0.10	-	-
Susp.Solids "	28	10	17	119	7	23	28	2	14	54	1	12	108	2	19	-	-	-
Dis.Solids "	220	210	220	266	128	225	274	164	228	267	158	223	523	200	247	275	-	-
Conductivity umho/cm	420	390	400	470	310	372	500	275	366	420	300	340	470	304	386	-	-	-
MBAS mg/l	-	-	-	.39	.05	.15	.26	.05	.17	.46	.08	.15(1)	.21	.10	.17(1)	0.5	-	0.3
Color units	-	-	-	-	-	-	7	0	3	8	0	2	25	0	4.1	30	-	10
Turbidity "	-	-	-	55	1.6	16	29	0.2	12	19	.15	7.4	7.8	.2	2.0	-	-	-
Number of Samples	3			51			42			37			25					

*Indiana Regulation SPC-7 (1) 6 samples (1) 6 samples

January and June 1969. The reason for this lack of improvement is that the terminal plant projects of the three large steel companies are not yet complete. These treatment plants are designed to handle the bulk of the wastes that were being discharged during 1965. Completed portions of the industrial programs are reflected by a continued reduction of sulfate. Table 14 shows that the average sulfate concentration at station 6 has been reduced from 64 mg/l in December, 1965 to 35 mg/l in 1968-1969. Table 15 shows that the criteria for sulfate has not been violated since 1966. This is a result of conversion to hydrochloric acid pickling and deep well injection acid disposal systems that have been completed. Phenol concentrations have also been significantly reduced. The data indicates that although the criteria are not actually being met, a great deal of progress has been made toward meeting the phenol requirements in Indiana Harbor. The maximum phenol concentrations, which usually occur in January, have decreased from 675 ug/l during 1967 to 33 ug/l in 1968 and 34 ug/l in 1969. The average phenol concentration at station 6 was 7.4 ug/l during 1968 which is considerably lower than during previous years. This progress is the result of the diversion of coke plant wastes from the harbor and canal. The larger fraction of phenol violations during 1969 shown in Table 15 is due to the fact that more January and February samples were taken during 1969. The bulk of the violations occurred during those months. Summaries of the evaluations of trends in water quality at stations 4 and 6 are shown in Tables 16 and 17.

TABLE 15
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 6 INDIANA HARBOR CANAL AT EAST BREAKWALL INNER LIGHT

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966	1967	1968	1969 Jan-June	1966	1967	1968	1969 Jan-June
Coliform Bacteria MPN/100 ml	Annual Avg. ≤2,000 Single Daily Value ≤5,000 except during periods of runoff	33 M	55 M	122 M	32 M	43/51 (2)	31/42	27/34	15/22
Fecal Streptococci Number/100 ml	Single Daily Value ≤100					36/51	31/42	16/34	13/22
True Color Units	Annual Avg. ≤10 Single Daily Value ≤30	NA (3)	NA	- (4)	-	NA	NA	-	-
Threshold Odor Units	Annual Avg. ≤12 Single Daily Value ≤36	NA	NA	NA	NA	NA	NA	NA	NA
Temperature, °C	Maximum 32.2°C	-	-	-	-	-	-	-	-
pH, Units	Annual Median 7.5-8.5 Daily Median 7.0-9.0	7.0 med.	7.3 med.	7.4 med.	7.3 med.	20/51	12/42	4/35	-
Dissolved Oxygen mg/l	Annual Avg. ≥4.0 Single Daily Value ≥2.0	-	-	-	-	1/51	2/42	1/35	-
Ammonia Nitrogen(N) mg/l	Annual Avg. ≤1.0 Single Daily Value ≤1.5	1.7	1.7	1.5	2.2	29/51	19/42	5/12	5/6
Methylene Blue Active Substance (MBAS), mg/l	Annual Avg. ≤0.3 Single Daily Value ≤0.5	-	-	-	-	-	-	-	-

TABLE 15 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 6 INDIANA HARBOR CANAL AT EAST BREAKWALL INNER LIGHT

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966	1967	1968	1969 Jan-June	1966	1967	1968	1969 Jan-June
Chlorides (Cl) mg/l	Annual Avg. ≤ 25 Single Daily Value ≤ 35	-	-	-	28	-	3/42	1/12	-
Cyanides (CN) mg/l	Single Daily Value ≤ 0.1					14/41	17/42	10/37	14/25
Fluorides (F) mg/l	Annual Avg. ≤ 1.0 Single Daily Value ≤ 1.3	NA	NA	NA	NA	NA	NA	NA	NA
Dissolved Iron (Fe) mg/l	Annual Avg. ≤ 0.15 Single Daily Value ≤ 0.30	NA	NA	-	-	NA	NA	3/35	1/25
Phenol-like Substances, mg/l	Annual Avg. ≤ 0.005 Single Daily Value ≤ 0.010	.021	.053	.008	.015	25/51	25/42	8/37	18/24
Sulfates (SO_4) mg/l	Annual Avg. ≤ 60 Single Daily Value ≤ 75	-	-	-	-	4/51	-	-	-
Dissolved Solids (Filterable Residue) mg/l	Single Daily Value ≤ 275					-	-	-	2/25
Total Phosphorus (P) mg/l	Annual Avg. ≤ .016 Single Daily Value ≤ .033	.065	.244	.132	.23	42/51	41/42	34/36	24/24

TABLE 15 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 6 INDIANA HARBOR CANAL AT EAST BREAKWALL INNER LIGHT

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966	1967	1968	1969 Jan-June	1966	1967	1968	1969 Jan-June

(1) Criteria for Station 6 is Indiana Regulation SPC 7.
(2) 43/51 Number of days criteria exceeded/number of days measurements were made.
(3) NA No measurements available.
(4) - Criteria not exceeded.

≤ Less or equal.
≥ Greater or equal.

TABLE 16

STATION NO. 4 INDIANA HARBOR CANAL AT PIERHEAD LIGHTS
SUMMARY OF EVALUATION OF TRENDS IN WATER QUALITY
August 1965 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliforms, No/100m			X
Fecal Strep.			X
Fecal Coliform "			X
pH			X
DO mg/l			X
BOD mg/l			X
COD mg/l	X		
Chlorides mg/l			X
Sulfate mg/l	X		
NH_3-N mg/l			X
NO_2 + NO_3 - N mg/l			X
Org N mg/l			X
Total P mg/l		X	
Total Iron mg/l			X
Phenol ug/l	X		
Oil & Grease mg/l	X		
Susp. Solids mg/l			X
Diss. Solids mg/l			X
Conductivity, umho/cm	X		
MBAS mg/l			X

TABLE 17

STATION NO. 6 INDIANA HARBOR AT EAST BREAKWALL INNER LIGHT
SUMMARY OF EVALUATION OF TRENDS IN WATER QUALITY
December 1965 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliforms, No/100ml ..... **			X
Fecal Strep. No/100ml ..... **			X
Fecal Coliform, No/100ml ..... **			X
pH ..... **			X
Dissolved Oxygen mg/l ..... **			X
BOD mg/l			X
COD mg/l ..... **		X	
Chlorides mg/l ..... **			X
Sulfate mg/l ..... **	X		
NH_3-N mg/l ..... **			X
NO_2 + NO_3 - N mg/l			X
Org N mg/l			X
Total P mg/l ..... **		X	
Total Iron mg/l	X		
Phenol ug/l ..... **	X		
Oil & Grease mg/l		X	
Cyanide mg/l ..... **			X
Susp. Solids mg/l			X
Diss. Solids mg/l ..... **		X	
Conductivity umho/cm			X
MBAS mg/l ..... *			X

* Parameter included in water quality criteria

** Parameter included in water quality criteria and water quality criteria violated

Station 7 - Grand Calumet River at the Indiana Belt R.R. Bridge. This station, a conference-approved water quality control point is located on Grand Calumet River in Illinois within a few hundred yards of the Indiana State Line. Criteria having application are identical for Indiana and Illinois, being Regulation SPC 8 and Rules and Regulation SWB-7, Rule 1.07, respectively. With an uncertain high point of the river in Hammond, the effluent from the Hammond plant may flow either easterly or westerly, depending on lake levels and areas of precipitation, but the normal flow to the west consists of a chlorinated Hammond sewage treatment works effluent and minor amounts of industrial effluent. Precipitation causes combined sewer overflows and land drainage including that from swampy areas. At the sampling point the stream flows to the west.

Considering all parameters, more values show a tendency for degradation of water quality than improvement. Since the base flow in the stream is the effluent from the Hammond sewage treatment plant, the amount of rainfall and runoff materially affects the concentrations at the sampling point. It appears that dissolved oxygen levels have risen. Without consideration of available dilution, the data show slightly increased values for ammonia, phosphorous, and biochemical oxygen demand. Chlorides, cyanides and minerals appear unchanged. Although chlorination of sewage effluents should result in reduction of bacterial densities, the effect is not yet clearly apparent and is most likely influenced by presence of increased amounts of ammonia in Hammond sewage. The data shows increasing amounts of phenols and ammonia.

The effluent from the Hammond sewage treatment plant has deteriorated since 1965; this plus combined sewer overflows contribute to the worsening conditions. A summary of water quality measurements is shown in Table 18 violations of water quality criteria in Table 19 and trends in water quality in Table 20.

Station 8 - Little Calumet River at Wentworth Avenue. This station, located about one-half mile downstream in Illinois from Indiana State line, is the control point to monitor water quality in Little Calumet River. Criteria applied at this point are identical for Indiana (Regulation SPC 9) and for Illinois (Rules and Regulation SWB-7, Rule 1.03). Little Calumet River drains a partly urbanized watershed so that flow responds quickly to rainfall. Dry weather flow is 5 to 10 cfs, but runoff periods may cause a flow as much as 500 cfs. The discharges from combined sewer overflows and from pumping stations constitute the major pollutional load. Upstream from Wentworth Avenue, sewage treatment plants serve Dyer and Schererville. The Simmons Company, Munster, the only industry on this watershed that discharges treated effluent to the stream, continues to provide adequate treatment and control. Hammond Sanitary District serves Munster and has intercepted the dry weather flows originating in Griffith and Highland areas that formerly discharged to the river.

During 1968 the total coliform bacteria counts were higher, but values of fecal streptococci and fecal coliforms did not significantly change; some improvement was indicated in the first half of 1969. Table 21 shows a reduction in concentrations of phosphates and phenols for

TABLE 18

. SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 7 GRAND CALUMET RIVER AT INDIANA BELT R. R. BRIDGE

Parameter		Sept-Dec 1965			Jan-Dec 1966			Jan-Dec 1967			Jan-Dec 1968			Jan-June 1969		
		Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean	Max	Min	Mean
Temp.	°C	21	5	13	28	3	14	24	0	13	27	4	17	18	0	11
Tot.Coli.per	100ml	8900M	100M	1700M	5300M	1800M	677M	9500M	2M	353M	7500M	7500M	550M	2100M	1000M	354M
Fec.Strep.	"	330M	40M	35M	94M	170	13M	110M	90	8300	160M	100	13M	35M	100	9700
Fec.Coli.	"	-	-	-	700M	980	55M	750M	200	104M	1500M	300	110M	430M	400	63M
pH		7.4	6.5	-	8.2	6.8	-	7.6	6.5	-	7.8	6.4	-	7.9	6.8	7.4
Dis.Oxygen	mg/l	8.0	0	4.1	9.6	0.0	4.1	11.6	0.0	5.1	5.5	0.0	2.8	6.1	.05	3.4
BOD	"	24	35	8.3	104	2.6	20	61	3.1	14	67	1.5	22	136	13	55
COD	"	155	15	56	224	13	57	160	12	66	297	23	125	340	69	164
Chlorides	"	-	-	-	180	22	81	212	29	96	315	50	96	142	80	96
Sulfate	"	282	52	174	280	76	178	430	95	189	396	65	155	200	110	166
NH_3-N	"	11	1.2	4.6	13	0.3	4.2	14	1.1	6.6	21	2.6	11	15	3.9	8.4
NO_2-NO_3-N	"	13	1.2	5.0	15	1.1	6.3	16	.03	2.9	4.6	0.01	0.4	1.3	.02	.14
Org.Nitrogen	"	4.6	.05	1.7	11.9	0.5	2.3	8.1	0.0	2.4	7	0	2.3	5.4	0.2	3.0
Total Phos.	"	4.57	1.08	2.67	5.54	.294	3.03	16.95	1.33	5.06	13.2	1.5	6.4	9.2	0.5	5.4
Sol.Phos.	"	3.59	.407	1.92	5.21	.098	1.92	11.08	.326	3.63	8.37	1.7	4.49	-	-	-
Dis.Iron	"	-	-	-	-	-	-	-	-	-	1.1	0	.36	.78	.10	.32
Tot.Iron	"	17	.27	2.0	7.9	.026	1.4	8.1	.21	1.5	6.4	.4	2.1	5.4	.5	2.9
Phenol	ug/l	46	4	15	90	3.0	18	120	2	16	70	8	24	46	11	26
MBAS	mg/l	-	-	-	1.8	.15	.72	3.4	.37	.81	4.2	0.44	1.3	5.5	0.4	1.3
Cyanide	"	.12	0.0	.01	.05	0.0	.01	.05	0	.01	.07	0.0	.02	.04	0	.02
Susp.Solids	"	155	7	27	110	4	27	102	4	29	110	10	40	132	17	65
Dis.Solids	"	750	58	577	770	90	614	925	234	661	1148	483	684	763	538	669
Cnductvy	umho/cm	-	-	-	1500	410	946	1500	365	1000	1840	750	1034	1200	838	1020
Turbidity	units	-	-	-	30	1.0	5.4	28	2.7	13	37	0.2	12	22	0.4	2.8
Color	units	-	-	-	-	-	-	30	2	14	35	3	21	45	3	24
No. of Samples			18			51			42			38			25	

M = Thousand

TABLE 19

SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 7 - GRAND CALUMET RIVER AT INDIANA BELT R.R. BRIDGE

Parameter		Criteria (1)	Average Measurements and Violations of Annual Criteria					Violations of Daily Criteria				
			1965 Sep.-Dec.	1966	1967	1968	1969 Jan.-June	1965 Sep.-Dec.	1966	1967	1968	1969 Jan.-June
Coliform Bacteria Number/100 ml		≤ 5000	17[illegible]M*	[illegible]M*	[illegible]M*	[illegible]M*	394M*	18/18 (2)	46/48	34/41	36/36	21/23
Fecal Streptococci Number/100 ml		≤ [illegible]	[illegible]M*	13M*	[illegible]*	13M*	[illegible]*	12/18	45/48	38/41	32/36	17/23
True Color Units	Annual Avg.	≤ 25	NA(3)	NA	14	21	24					
	Single Day	≤ [illegible]						NA	NA	(0/5)	0/37	0/25
Temperature, °F		≤ *	[illegible]	[illegible]	75	[illegible]1	64	0/18	0/48	0/42	0/37	0/25
pH, Units	Daily Range	[illegible]-[illegible]						0/18	0/48	0/42	2/37	1/25
Dissolved Oxygen mg/l	May-Oct. Avg.	≥ 3.0	2.3*	4.1	5.1	2.[illegible]*	NA					
	Single Day	≥ 1.0						2/18	3/48	1/42	1/37	NA
Ammonia Nitrogen mg/l	Single Day	≤ 5.0						7/18	14/48	28/42	35/37	23/25
BOD, mg/l	Single Day	≤ 10.0						3/17	25/48	16/37	32/37	21/21
MBAS, mg/l	Single Day	≤ [illegible].5						M*	(35/41)	26/42	34/37	22/25
Chlorides, mg/l	Annual Avg.	≤ 75	NA	[illegible]1*	[illegible]*	[illegible]*	[illegible]*					
	Single Day	≤ 125						NA	(1/41)	3/42	3/37	1/25

TABLE 19 (CONTINUED)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 7 - GRAND CALUMET RIVER AT INDIANA BELT R.R. BRIDGE

Parameter	Criteria (1)	Average Measurements and Violations of Annual Criteria					Violations of Daily Criteria				
		1965 Sep.-Dec.	1966	1967	1968	1969 Jan.-June	1965 Sep.-Dec.	1966	1967	1968	1969 Jan.-June
Filtrable Residue, mg/l	Single Day ≤ 500						14/18	43/48	41/42	37/38	25/25
Phenols, mg/l	Single Day ≤ 0.020						2/17	10/48	11/42	19/38	18/23

(1) Station 7 is a control point. Violations are based on Illinois Rules and Regulations SWP 7-Rule 1.05. This is the same criteria as Indiana Regulation SRC 8.
• Violated annual criteria.
(2) 18/18 = Number of days criteria exceeded/number of days measurements were made.
(3) NA = No measurements available.
M Thousand.
≤ = Less or equal.
≥ = Greater or equal.
( ) = For part of year.

TABLE 20
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 7 GRAND CALUMET RIVER AT INDIANA HARBOR BELT R. R. BRIDGE
Sept. 1965 - June 1969

Parameter		Apparent Improvement in Water Quality	Apparent Degradation in Water Quality	No Apparent Change in Water Quality
Temperature	*			X
Total Coliforms	**			X
Fecal Streptococci	**			X
Fecal Coliforms				X
pH	**			X
Dissolved Oxygen	**	X		
BOD	**		X	
COD			X	
Chlorides	**			X
Sulfates				X
Ammonia Nitrogen	**		X	
Nitrite - Nitrate Nitrogen		X		
Organic Nitrogen				X
Total Phosphorous			X	
Soluble Phosphorous			X	
Dissolved Iron				X
Total Iron				X
Phenols	**		X	
MBAS	**			X
Cyanide				X
Suspended Solids				X
Dissolved Solids	**			X
Conductivity				X
Turbidity				X
Color	*			X

* Parameter included in water quality criteria
** Parameter included in water quality criteria and water quality criteria violated

TABLE **21**

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 8 LITTLE CALUMET RIVER AT WENTWORTH AVENUE

Parameter	July-Dec 1965			Jan-Dec 1966			Jan-Dec 1967			Jan-Dec 1968			Jan-June 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	24	0	13	30	0	11	24	0	11	27	0	14	18	0	7.3
Tot.Coli.per 100ml	3900M	69M	761M	2200M	1000	348M	6200M	2000	362M	6500M	1000	661M	830M	100	98M
Fec.Strep. "	169M	100	24M	160M	100	11M	75M	140	8000	59M	100	11M	10M	10	2M
Fec.Coli. "	-	-	-	370M	2000	70M	2000M	1500	100M	940M	100	103M	83M	100	14M
pH	8.8	7.1	-	8.1	6.9	-	8.9	6.7	-	8.4	6.4	7.4	8.4	7.2	7.7
Dis.Oxygen mg/l	9.8	0.0	3.3	11.0	0.1	5.0	11.8	0.0	5.5	10.9	0.4	4.1	12.6	0.4	8.0
BOD "	35	3.9	11	17	3.9	8.1	30	4.1	9.7	22	3.3	10	17	4	9.7
COD "	151	5.9	51	89	19	45	76	13	44	-	-	-	-	-	-
Chlorides "	-	-	-	80	17	47	90	13	49	94	21	52	60	24	43
Sulfate "	310	57	175	325	100	201	480	30	180	255	215	230	-	-	-
NH_3-N "	3.7	.30	2.0	6.0	0.30	2.0	9.8	0.3	2.5	8.5	0.5	3.9	7.6	0.7	2.4
NO_2-NO_3-N "	5.4	.04	1.7	9.3	.10	1.7	3.9	.02	1.7	6	0.8	2.1	5.8	0.7	2.1
Org.Nitrogen "	6.2	.13	2.6	7.2	0.3	1.7	3.8	0.1	1.7	2.3	0	1.2	2.4	0	1.1
Total Phos. "	4.65	.359	1.50	3.59	.071	1.60	.20	.391	2.04	2.9	.13	1.33	1.45	.09	.69
Sol.Phos. "	3.16	.085	1.00	3.22	.055	1.24	.71	.150	1.43	2.08	.10	1.11	-	-	-
MBAS "	-	-	-	.86	.15	.38	1.3	.19	.54	.95	.21	.39	.49	.14	.27
Total Iron "	3.8	.45	1.3	3.1	.38	.87	32.0	.28	2.4	-	-	-	-	-	-
Phenol ug/l	59	0	11	65	.24	11	42	0.3	9	32	0	6	32	0	8.1
Color units	-	-	-	-	-	-	-	-	-	70	5	23	55	3	33
Cyanide mg/l	.18	0.0	.01	.66	0.0	.02	.05	0.0	.01	.05	0	.02	.09	0	.01
Susp.Solids "	704	10	106	980	5	64	856	7	64	480	6	46	340	5	75
Dis.Solids "	770	109	565	907	194	623	865	204	604	1005	326	670	770	198	562
Cnductvy umho/cm	-	-	-	1300	425	931	1360	345	860	1390	36	955	1150	285	800
Turbidity units	-	-	-	103	1.0	12	470	1.4	27	310	.21	19	62	0.4	12
No. of Samples		25			50			44			38			24	

M = Thousand

TABLE 22
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 8 - LITTLE CALUMET RIVER AT WENTWORTH AVENUE

Parameter	Criteria (1)		Average Measurements and Violations of Annual Criteria					Violations of Daily Criteria				
			1965 July-Dec.	1966	1967	1968	1969 Jan.-June	1965 July-Dec.	1966	1967	1968	1969 Jan.-June
Coliform Bacteria No./100 ml (Except stormwater)		≤ 5000	761M*	340M*	362M*	661M*	38M*	24/24 (2)	44/48	42/43	33/36	20/22
Fecal Streptococci No./100 ml (Except stormwater)		≤ 500	24M*	11M*	8000*	11M*	2M*	21/24	40/48	40/44	26/36	18/22
True Color Units	Annual Avg.	≤ 25	NA(3)	NA	(29)*	23	33*					
	Single Day	≤ 50						NA	NA	(1/5)	2/38	4/24
Temperature, °F	Single Day	≤ 90	55	52	52	57	7	0/25	0/48	0/44	0/38	0/24
pH, Units	Daily Range 6.5-9.0							0/25	0/48	0/44	1/38	0/24
Dissolved Oxygen mg/l	May-Sep.Avg	≥ 4.0	1.6*	2.8*	3.0*	2.0*	NA					
	Single Day	≥ 2.0						8/12	13/48	12/44	15/38	NA
Ammonia Nitrogen mg/l	Single Day	≤ 1.5						18/26	24/48	28/45	32/37	13/24
BOD, mg/l	Single Day	≤ 10.0						8/25	11/47	11/41	17/35	7/20
MBAS, mg/l	Single Day	≤ 0.5						NA	(8/42)	20/44	10/38	0/24
Cyanides, mg/l	Single Day	≤ 0.025						2/23	1/48	3/44	8/38	1/24
Phenols, mg/l	Single Day	≤ 0.02						3/25	6/48	4/44	1/38	2/23

TABLE 22 (CONTINUED)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
STATION 8 - LITTLE CALUMET RIVER AT WENTWORTH AVENUE

Parameter	Criteria (1)	Average Measurements and Violations of Annual Criteria					Violations of Daily Criteria				
		1965 July-Dec.	1966	1967	1968	1969 Jan.-June	1965 Sep.-Dec.	1966	1967	1968	1969 Jan.-June

(1) Station 8 is a control point. Violations are based on Illinois Rules and Regulations SWB 7-Rule 1.03. This is the same criteria as Indiana Regulation SPC 9.

• Violated annual criteria.

(2) 24/24 = Number of days criteria exceeded/number of days measurements were made.

(3) NA = No measurements available.

M Thousand

≤ = Less or equal.

≥ = Greater or equal.

( ) = For part of year.

TABLE 23
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 8 LITTLE CALUMET RIVER AT WENTWORTH AVENUE
July 1965 - June 1969

Parameter		Apparent Improvement in Water Quality	Apparent Degradation in Water Quality	No Apparent Change in Water Quality
Temperature	*			X
Total Coliforms	**		X	
Fecal Streptococci	**			X
Fecal Coliforms				X
pH	**			X
Dissolved Oxygen	**		X	
BOD	**			X
Chlorides				X
Sulfates			X	
NH_3-N	**		X	
NO_2-NO_3-N				X
Organic Nitrogen				X
Total Phosphorous		X		
Soluble Phosphorous		X		
Phenols	**	X		
MBAS	**			X
Cyanide	**			X
Suspended Solids				X
Dissolved Solids				X
Conductivity				X
Turbidity				X
Color	**			X

* Parameter included in water quality criteria
** Parameter included in water quality criteria and water quality criteria violated

1966 through 1968. Worsening effects are noted in lower dissolved oxygen and higher ammonia levels. Other parameters such as BOD, chlorides, suspended and dissolved materials, and nitrate and organic nitrogen are not significantly changed in concentration. The data shows a slight upward trend in concentration of ammonia. Summaries of violations of water quality criteria and evaluations of trends in water quality at station 8 are shown in Tables 22 and 23.

Stations 9 and 10 - Wolf Lake State Line and Outlet. Wolf Lake, located astride the Indiana-Illinois State line, has been sampled routinely at two points. Station 10, located on the Wolf Lake Outlet at Carondolet Ave. about 3000 feet downstream from Wolf Lake, monitors the quality of the water leaving the Lake. Station 9 is on the State line which runs along a causeway crossing the Lake. This station monitors the quality of the water at the State line, having been established as a control point by the conferees. The applicable criteria of these waters are identical for the States of Indiana (Indiana Regulation SPC 10) and Illinois (Rules and Regulations SWB-7, Rule 1.04). Wolf Lake is a high quality body of water extensively used for fishing, boating, swimming and all forms of water-associated recreation. On the Indiana side there is a popular public beach at 121st Street in Hammond and on the Illinois side there is a game preserve and extensive park areas used for picnics, fishing and other activities. During the spring and fall large numbers of migratory water fowl use the Lake as a refuge.

Judged by the Lake Michigan shorewater criteria of 5000 per 100 ml as a maximum number of total coliform bacteria and 100 per 100 ml

as a maximum number of Fecal Streptococci, previous records were reported with no violation during the first part of 1968. However, using a 5-day moving average and evaluating data in combinations with relative numbers of fecal streptococcus as provided in the applicable state criteria, a substantial percentage of violations occur. High fecal streptococci levels are the usual cause for values in violation, such levels probably resulting from contamination by aquatic birds. Total phosphorous, having shown an increase through 1968, generally exceeded the maximums permitted at the State line station, but waters were in usual conformity at the outlet station, and although phosphorous may be incorporated in bottom debris and growths, it does not completely account for its apparent removal. Nutrients are at levels conducive to profuse algal growths. Dissolved oxygen levels were usually at saturation or higher values except that low saturation values were often associated with ice cover.

Lever Brothers Company is the only industry discharging treated wastewater into Wolf Lake Channel in Indiana. Effluent quality continues to improve following in-plant installations. Inasmuch as the area drained by Wolf Lake is small, most of the flow is effluent discharged from the Lever Company which obtains its water supply from Lake Michigan. Storm sewers on Indianapolis Boulevard discharge strong wastes to the Lake.

Phenolic materials were found in amounts up to 20 ug/l in 1968 as compared with one high of 57 in 1967. The 1968 average of about 4 is that of previous annual values. Slug discharges should be traced and

eliminated to prevent toxic effects on aquatic life and to enhance the palatability of fish. Statistical measures for the water quality at the State line sampling point (Station 9) and for the Wolf Lake outlet (Station 10) are included in Tables 24 and 25. Summaries of violations of water quality criteria and evaluations of trends in water quality are shown in Tables 26, 27, 28, and 29.

Stations 11 and 13 - Calumet Harbor. Station 11 is located at the mouth of the Calumet River immediately adjacent to the north pierhead light. Station 13 is located in mid-harbor approximately 3,500 feet from the mouth of the river. This station monitors the quality of the water flowing from Lake Michigan to the river. No criteria have been established that apply specifically to these points, but the criteria for Lake Michigan Inner Harbor Basins developed by the Calumet Area Technical Committee were used to judge the suitability of water quality. Water quality measurements are summarized in Tables 30 and 31.

The water quality at stations 11 and 13 has improved in water quality for the period of January 1966 through the first six months of 1969 in the following parameters: bacterial quality, total coliform, fecal coli and fecal streptococcus, suspended solids, sulphates, turbidity and total iron. The ammonia, cyanides and phosphate values have remained at the same general levels for this period. The maximum values for phenols have been decreasing while the mean values have been increasing. A summary of the violations of water quality criteria at station 11 is shown in Table 32 and summaries of evaluations of trends in water quality at stations 11 and 13 are shown in Tables 33 and 34.

TABLE 24

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 9 WOLF LAKE AT INDIANA-ILLINOIS STATE LINE CULVERT

Parameter	Oct-Dec 1965			Jan-Dec 1966			Jan-Dec 1967			Jan-Dec 1968			Jan-June 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	15	0	4	29	0	11	25	0	11	30	0	14	19	1	7.8
Total Coli.per 100ml	5400	5	960	4300	2	255	4000	4	265	1000	5	574	230	5	25
Fec.Strep. "	220	1	47	1200	1	41	190	2	18	1000	5	108	30	5	8.3
Fec.Coli. "	-	-	-	900	1	84	350	2	54	1300	5	64	60	5	8
pH	8.2	7.7	-	9.3	7.4	-	9.8	6.7	-	8.8	6.8	-	9.0	6.8	8.0
DisOxygen % sat.	106	72	95	115	62	93	106	73	89	99	80	91	110	39	84
BOD mg/l	5.5	1.2	3.2	11	1.6	4.7	8.9	2.5	4.8	-	-	-	-	-	-
COD "	134	6.4	42	55	10	25	69	14	28	-	-	-	-	-	-
Chlorides "	-	-	-	38	20	28	38	20	29	38	29	33	-	-	-
Sulfate "	60	46	50	69	37	51	70	32	51	59	50	54	-	-	-
NH_3-N "	.38	.07	.24	.56	.03	.25	.74	.02	.27	.4	.02	.12	.38	.02	.18
NO_2-NO_3-N "	.86	.38	.58	1.2	.03	.36	0.5	0.2	.19	.27	0.0	.06	.24	.01	.10
Org.Nitrogen "	1.00	.45	.69	2.0	.51	.98	13.0	.30	1.5	2.1	.16	1.03	1.27	.23	.70
Total Phos. "	.098	.020	.042	.111	.013	.050	.137	.023	.060	.30	.01	.08	.094	.024	.039
Sol.Phos. "	.094	.006	.033	.104	.011	.036	.117	.013	.038	.04	.01	.06	-	-	-
MBAS "	-	-	-	.19	.09	.13	.30	.07	.14	.33	.06	.12	.16	.09	.12
Total Iron "	.97	.08	.28	.74	.04	.25	1.0	.05	.42	-	-	-	-	-	-
Phenol ug/l	20	0.0	4	19	0.0	3.2	57	0	5	20	0	4	15	1	5.2
Turbidity units	-	-	-	12	0.5	3.5	18	0.6	8	31	9.2	10	43	.22	1.2
Cyanide mg/l	.01	0.0	0.0	.35	0.0	.01	.01	0.0	0.0	.01	0.0	0.0	.01	0	.0004
Susp.Solids "	51	2	11	48	4	14	65	2	15	45	1	24	32	0	15
Dis.Solids "	285	255	264	320	180	249	342	197	260	297	180	236	277	179	249
Conductivity umho/cm	-	-	-	500	335	400	510	330	395	500	290	377	470	314	391
Color units	-	-	-	-	-	-	-	-	-	25	0	5	25	0	5
No. of Samples		11			52			43			57			25	

TABLE 25

SUMMARY OF WATER QUALITY MEASUREMENTS

STATION 10 WOLF LAKE OUTLET AT CARONDELET AVENUE

Parameter	Oct-Dec 1965			Jan-Dec 1966			Jan-Dec 1967			Jan-Dec 1968			Jan-June 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	16	1	5	28	0	11	24	0	10	29	0	15	19	0	7.7
Tot.Coli.per 100ml	1500	1	410	2900	5	650	6500	5	670	9500	5	1600	300	10	100
Fec.Strep. "	220	1	65	700	1	120	1000	2	118	2200	5	190	370	5	71
Fec.Coli. "	-	-	-	2400	2	190	1500	2	130	800	5	90	90	5	33
pH	8.6	8.1	-	8.8	7.9	-	9.9	7.4	-	9.3	6.5	-	9.1	7.4	8.5
Dis.Oxygen % Sat.	99	68	89	100	68	86	97	72	86	99	63	83	103	66	84
BOD mg/l	2.6	1.7	2.2	7.6	1.9	3.8	24	0.5	4.5	-	-	-	-	-	-
COD "	138	0.8	52	58	11	22	58	11	22	-	-	-	-	-	-
Chlorides "	-	-	-	43	26	34	42	21	33	32	25	29	-	-	-
Sulfate "	72	45	64	92	52	73	79	29	60	66	63	64	-	-	-
NH_3-N "	.33	.06	.20	.67	.01	.23	.38	.02	.19	.41	.03	.14	.49	.03	.29
NO_2-NO_3-N "	.60	.12	.30	.67	.01	.30	.92	0.0	.20	.44	.01	.09	.32	.01	.16
Org.Nitrogen "	.83	.44	.58	1.1	.28	.70	1.0	0.31	.65	.95	.34	.58	1.0	.07	0.6
Total Phos. "	.160	.016	.026	.088	.010	.026	.095	.016	.029	.194	.004	.033	.07	.012	.025
Sol. Phos. "	.078	.007	.016	.036	.007	.016	.049	.007	.021	.027	.003	.018	-	-	-
MBAS "	-	-	-	.24	.08	.13	.44	.05	.14	.20	.06	.14	.17	.10	.12
Total Iron "	.37	.04	.22	.77	.05	.19	1.3	.07	.41	-	-	-	-	-	-
Phenol ug/l	8	0	4	20	1	6	50	0	9	35	0	7	39	0	13
Turbidity units	-	-	-	-	-	-	-	-	-	15	.11	6	2.2	0.2	0.8
Cyanide mg/l	0.0	0.0	0.0	.02	0.0	0.0	-	-	-	-	-	-	-	-	-
Susp.Solids "	24	2	13	65	2	21	50	2	17	65	2	23	46	2	20
Dis.Solids "	305	245	281	343	172	274	315	214	263	293	208	254	306	216	264
Cnductvy umho/cm	-	-	-	545	350	450	550	260	408	480	330	398	482	358	417
Color units	-	-	-	-	-	-	-	-	-	12	0	3	25	0	3.8
No. of Samples	11			52			43			15			25		

TABLE 26

SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA

STATION 9 - WOLF LAKE AT INDIANA-ILLINOIS STATE LINE CULVERT

Parameter	Criteria (4)	Average Measurements and Violations of Annual Criteria					Violations of Daily Criteria				
		1965 Oct.-Dec.	1966	1967	1968	1969 Jan.-June	1965 Oct.-Dec.	1966	1967	1968	1969 Jan.-June
Coliform Bacteria No./100 ml	≤ 1000 and/or	(1)	(1)	(1)	(1)	(1)	(2)(5)	(2)	(2)	(2)	(2)
Fecal Streptococci No./100 ml	1000 to 5000 and ≤100	*60	355	253	574	25	2/8	(1/22)	(0/28)	(10/20)	0/23
	≤ 20	47	41	19	100	8					
True Color, Units	Annual Avg. ≥ 5	NA(6)	NA	NA	5	5					
	Single Day ≤15						NA	NA	0/5	3/36	3/25
Temperature, °F	≤85	59(3)	84(3)	77(3)	86(3)	86(3)	0/11	0/51	0/53	0/37	0/25
pH, Units	Daily Range 7.0-8.5						0/11	1/52	2/53	1/37	2/25
Dissolved Oxygen, % Saturation	Annual Avg ≥ 60	85	43	59*	41	54*					
	Single Day ≥ 50						1/11	2/51	3/43	0/37	NA
Ammonia Nitrogen, mg/l	Annual Avg ≤0.05	.24*	.29*	.20*	.12*	.18*					
	Single Day ≤0.12						11/12	41/52	19/42	13/36	16/25
MBAS, mg/l	Annual Avg ≤0.02	NA	.13*	.14*	.12*	.12*					
	Single Day ≤0.05						NA	45/45	43/43	37/37	25/25
Cyanides, mg/l	Single Day ≤0.025						0/11	2/42	0/43	0/37	0/25
Total Phosphates, mg/l (PO_4)	Annual Avg ≤0.03	.042*	.050*	.06*	.03*	.03*					
	Single Day ≤0.04						NA	NA	(3/6)	26/37	7/24

(1) Arithmetic average. (2) Based on values determined from 5-day moving average, May-Sept. (3) Maximum value.
(4) Station 9 is a control point. Violations are based on Illinois Rules and Regulations SWB 7-Rule 1.04. This is the same criteria as Indiana Regulation SPC 10.
(5) 2/8 = Number of days criteria exceeded/number of days measurements were made.
(6) NA = No measurements available.
* Violated annual criteria. ( ) = For part of year.

≤ = Less or equal. ≥ = Greater or equal.

TABLE 27

SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA

STATION 10 - WOLF LAKE OUTLET AT CARONDOLET AVENUE

Parameter	Criteria (4)	Average Measurements and Violations of Annual Criteria					Violations of Daily Criteria				
		1965 Oct.-Dec.	1966	1967	1968	1969 Jan.-June	1965 Oct.-Dec.	1966	1967	1968	1969 Jan.-June
Coliform Bacteria, No./100 ml	≤ 1000 and ≤ 100	(1) 410	(1) 650	(1) 670	(1) 1600	(1) 100					
	1000 to 5000 and ≤ 20										
Fecal Streptococci, No./100 ml		65	120	110	140	71	(2)(5) 2/8	(2) 22/52	(2) 20/43	(2) 12/36	(2) 5/23
True Color, Units	Annual Avg ≤ 5 Single Day ≤15	NA(6)	NA	NA	3	3.5	NA	NA	0/4	0/36	2/25
Temperature, °F	≤ 85	61(3)	82(3)	75(3)	84(3)	66(3)	0/11	0/52	0/43	0/37	0/25
pH, Units	Daily Range 7.0-9.0						0/11	1/52	0/43	4/34	2/25
Dissolved Oxygen % Saturation	Annual Avg. ≥ 90 Single Day ≥ 50	89*	86*	86*	89*	84*	1/11	10/52	2/43	4/36	NA
Ammonia Nitrogen, mg/l	Annual Avg. ≤ 0.05 Single Day ≤ 0.12	0.20*	0.23*	0.13*	0.14*	0.29*	9/11	41/52	23/43	16/37	25/25
MBAS, mg/l	Annual Avg. ≤ 0.02 Single Day ≤ 0.05	NA	.13*	.14*	.14*	0.12*	NA	(45/45)	42/43	34/36	23/23
Cyanides, mg/l	Single Day ≤ 0.025						0/11	(0/33)	NA	NA	NA
Total Phosphates (PO_4) mg/l	Annual Avg. ≤ 0.03 Single Day ≤ 0.04	.026	.026	.028	.033*	.025	NA	NA	(0/6)	10/37	2/24

(1) Arithmetic average. (2) Five-day moving average, May-Sept. (3) Maximum value.

(4) Station 10 is a second control point for S&B 7-Rule 1.04, which is the criteria on which these violations are based. This is the same criteria as Indiana Regulation SPC 10.

(5) 2/8 = Number of days criteria exceeded/number of days measurements were made.

(6) NA = No measurements available.

* Violated annual criteria. ( ) = For part of year.

≤ = Less or equal.

≥ = Greater or equal.

TABLE 28
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 9 WOLF LAKE AT INDIANA-ILLINOIS STATE LINE CULVERT
Oct. 1965 - June 1969

Parameter		Apparent Improvement in Water Quality	Apparent Degradation in Water Quality	No Apparent Change in Water Quality
Temperature	*			X
Total Coliforms	**			X
Fecal Streptococci	**			X
Fecal Coliforms				X
pH	**			X
Dissolved Oxygen	**		X	
Chlorides				X
Sulfates				X
NH_3-N	**			X
NO_2-NO_3-N		X		
Organic Nitrogen				X
Total Phosphorous	**	X		
Soluble Phosphorous		X		
Phenols				X
MBAS	**			X
Cyanide	**	X		
Suspended Solids				X
Dissolved Solids				X
Conductivity				X
Turbidity				X
Color	**			X

* Parameter included in water quality criteria
** Parameter included in water quality criteria and water quality criteria violated

TABLE 29
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
STATION 10 WOLF LAKE OUTLET AT CARONDOLET AVENUE
Oct. 1965 - June 1969

Parameter		Apparent Improvement in Water Quality	Apparent Degradation in Water Quality	No Apparent Change in Water Quality
Temperature	*			X
Total Coliforms	**		X	
Fecal Streptococci	**		X	
Fecal Coliforms		X		
pH	**			X
Dissolved Oxygen	**			X
NH_3-N	**			X
NO_2-NO_3-N		X		
Organic Nitrogen				X
Total Phosphorous	**			X
Phenols			X	
MBAS	**			X
Suspended Solids				X
Dissolved Solids				X
Conductivity				X
Turbidity		X		
Color	**	X		

* Parameter included in water quality criteria

** Parameter included in water quality criteria and water quality criteria violated

TABLE 51
SUMMARY OF WATER QUALITY MEASUREMENTS
STATION 13-CALUMET HARBOR

Parameter	Apr - Nov 1966			May - Oct 1967			Jan - Dec 1968			Criteria			Jan - June 1969		
	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean	Max.	Min.	Mean
Temp. °C	24	5	16	21	9	17	24	9.0	17.4	29.3			17	8	13.7
Tot.Coli.per 100ml	2300	6	460	1500	50	458	4300	20	592	5000		2000	80	40	63
Fec.Strep. " " "	3300	1	7	10	2	4	70	1	13	100			<5	<5	<5
Fec.Coli. " " "	1400	1	120	590	2	150	490	5.0	62.0				10	5	6
pH	8.1	7.4	--	8.2	7.4	--	8.20	7.6	8.19	9.0	7.5	6.0-8.5	8.2	7.7	8.0
Dis.Oxygen % sat.	97	71	89	102	71	85	111	86	97		60%	80%	95	82	90
BOD mg/l	4.3	1.0	2.3	7.0	0.6	1.8	5.4	1.0	2.31				5.4	4.3	5.2
COD "	22	2	11	17	3.9	9.3	23.0	2.4	9.58				21	7.9	16
Chlorides "	14	8	10	15	7	11	10.0	7.3	8.70	50		19	10	10	10
Sulfate "	33	16	24	31	20	24	28	5	14.8	75		36	3.0	1.3	2.4
NH_3-N "	.48	.04	.28	.40	.03	.21	0.27	.05	0.14	0.15		0.05	.15	.06	.10
NO_2-NO_3 "	.38	.04	.19	.43	.10	.20	0.34	.08	0.19				.21	.06	.12
Org.Nitrogen "	.56	.06	.28	.93	.23	.38	0.57	0.0	0.20				.33	.31	.32
Tot. Phos. "	.033	.013	.020	.033	.013	.027	.055	.004	.021	0.032		0.016	.143	.013	.055
Sol.Phos "	.023	0.0	.010	.026	.007	.015	--	--	--						
Dis. Iron "	--	--	--	--	--	--	0.330	0	.074				.100	0	.035
Tot. Iron "	2.1	.12	.57	1.10	.26	.55	7.58	0.05	0.684				.750	.190	.363
Phenol ug/l	11	0	2	5.8	0	2	5.0	0	0.70	5		2	8	0	3.3
Oil & Grease mg/l	--	--	--	--	--	--	3.7	0	1.7				3.4	0	2.2
Cyanide "	.01	0.0	0.0	.02	0	0.0	0.01	0	.003	0.1			.01	0	.003
Susp.Solids "	46	2	10	18	1	8	15	1.0	5.0				22	2	8.8
Dis. Solids "	210	126	177	200	152	175	203	164	178	230		190	205	158	187
Cnductvy umho/cm	315	270	296	310	260	280	300	255	272				295	254	275
MBAS mg/l	.11	.02	.05	.13	.02	.06	1.3	0.02	0.06	0.30		0.10	.03	.03	.03
Turbidity Units	19.9	0.6	2.7	8.0	0.2	3.3	5.0	0.20	2.0				5.7	.55	2.1
Color "	--	--	--	--	--	--	3.0	0	0.70				12	2	8
No. of Samples		29			18			6-20							

Calumet Area Conference - Criteria 2

TABLE 32

SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA - STATION 11 CALUMET RIVER AT MOUTH
JANUARY 1966 THROUGH JUNE 1967

Parameter	Criteria (1)		Violations of Annual Criteria 1966 Jan.	1967	1968	1967 June	Violations of Daily Criteria 1966 Jan.	1967	1968	1967 June
Coliform Bacteria MPN/100 ml	Annual Avg.	≤ 2,000	- (2)	-	-					
	Single Day	≤ 5,000					3/51(3)	1/48	1/35	0/20
Fecal Streptococci Number/100 ml	Single Day	≤ 100					8/51	3/48	5/35	0/21
True Color Units	Annual Avg.	≤ 5	NA (4)	-	-					
	Single Day	≤ 15					NA	0/5	0/36	1/24
Threshold Odor Units	Annual Avg.	≤ 8	NA	NA	NA					
	Single Day	≤ 20					NA	NA	NA	NA
Temperature, °F	Single Day	≤ 89					0/50	0/43	0/29	0/24
pH, Units	Annual Median	6.0-8.5	7.30	7.01	6.98*					
	Daily Median	7.5-8.0					6/51	5/46	3/37	6/24
Dissolved Oxygen Percent Saturation	Annual Avg.	≥ 80	80*	75	-					
	Single Day	≥ 65					6/43	7/38	0/30	0/24
Ammonia Nitrogen (N) mg/l	Annual Avg.	≤ .05	.31	.64	.21					
	Single Day	≤ .12					40/50	43/44	29/37	18/24
Methylene Blue Active Substance (MBAS), mg/l	Annual Avg.	≤ .10	-	-	-					
	Single Day	≤ .30					0/45	1/44	0/4	0/3

(1) Station 11 is not a control point. Violations are based on Illinois Rules and Regulations SWB 15-Rule 1.05, Calumet Harbor Basin. This is the same criteria as Indiana Regulation SPC 6, Lake Michigan Inner Harbor Basin.
(2) - = Criteria not exceeded.
(3) 3/51 = Number of days criteria exceeded/number of days measurements made.
(4) NA = No measurements available.

≤ = Less or equal.

≥ = Greater or equal

* Meets Criteria - Listed because it just meets criteria.

TABLE 32 (CONTINUED)

SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA - STATION 11 CALUMET RIVER AT MOUTH
JANUARY 1966 THROUGH JUNE 1969

Parameter	Criteria (1)		Violations of Annual Criteria 1966 Jan.	1967	1968	1969 June	Violations of Daily Criteria 1966 Jan.	1967	1968	1969 June
Chlorides (Cl)	Annual Avg.	≤ 18	-	-	-					
	Single Day	≤ 30					0/43	1/44	0/4	NA
Cyanides (CN) mg/l	Single Day	≤ .10					1/36	1/43	1/3	0/24
Fluorides (F) mg/l	Annual Avg.	≤ 1.0	NA	NA	NA					
	Single Day	≤ 1.3					NA	NA	NA	NA
Dissolved Iron (Fe) mg/l	Annual Avg.	≤ .15	NA	NA	-					
	Single Day	≤ .30					NA	NA	1/37	1/24
Phenol-like Substances, mg/l	Annual Avg.	≤ .007	.004	.011	.003					
	Single Day	≤ .005					4/50	13/44	4/3*	3/23
Sulphates (SO_4) mg/l	Annual Avg.	≤ 90	-	-	-					
	Single Day	≤ 75					0/51	0/44	0/36	0/22
Total Phosphates (P), mg/l	Annual Avg.	≤ .016	NA	.053	.035					
	Single Day	≤ .033					NA	6/6	10/36	12/22
Filterable Residue mg/l	Annual Avg.	≤ 160	-	-	-					
	Single Day	≤ 230					0/51	2/44	1/36	2/24

(1) Station 11 is not a control point. Violations are based on Illinois Rules and Regulations SWB 15-Rule 1.05, Calumet Harbor Basin. This is the same criteria as Indiana Regulation SPC 6, Lake Michigan Inner Harbor Basin.
(2) - = Criteria not exceeded.
(3) 3/51 = Number of days criteria exceeded/number of days measurements made.
(4) NA = No measurements available.

≤ = Less or equal.

≥ = Greater or equal.

* Meets Criteria - Listed because it just meets criteria.

TABLE 33

STATION 11 - CALUMET RIVER AT MOUTH
SUMMARY OF EVALUATION OF TRENDS - WATER QUALITY
January 1966 to June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliform** MPN/100 ml	X		
Fecal Strep** MPN/100 ml	X		
Fecal Coli MPN/100 ml	X		
pH Units**			X
Dissolved Oxygen** % Sat.	X		
Sulphates mg/l*	X		
Ammonia Nitrogen** mg/l			X
Total N mg/l	X		
MBAS mg/l**	X		
Chlorides mg/l**			X
Phenols ug/l**			X
Total Phosphates** mg/l (P)	X		
Oil and Grease mg/l			X
Suspended Solids mg/l	X		
True Color Units**		X	
Cyanides mg/l**			X
Dissolved Iron mg/l**			X

*Parameter included in water quality criteria.
**Parameter included in water quality criteria and water quality criteria violated.

TABLE 34

STATION 13 - CALUMET RIVER - MID HARBOR
SUMMARY OF EVALUATION OF TRENDS IN WATER QUALITY
January 1966 to June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Total Coliform MPN/100 ml	X		
Fecal Strep MPN/100 ml	X		
Fecal Coli MPN/100 ml	X		
pH Units			X
Dissolved Oxygen % Sat.			X
Sulphates mg/l	X		
Ammonia Nitrogen mg/l			X
Total N mg/l	X		
MBAS mg/l	X		
Chlorides mg/l			X
Phenols ug/l			X
Total Phosphates mg/l (P)			X
Oil and Grease mg/l		X	
Suspended Solids mg/l	X		
True Color Units			X
Cyanides mg/l			X
Dissolved Iron mg/l			X

Municipal Water Supply Sampling Stations 14, 15, 16, and 17. Water quality measurements at the Gary West, East Chicago, Hammond, and Chicago South water plant intakes are summarized in Tables 35 , 36 , 37 , and 38 . The violations of water quality criteria for which numerical values were specified are summarized in Table 39 . The estimated trends of changes in water quality were made by comparing measurements made during the same time period in succeeding years. For most parameters these included the full years of 1967 and 1968. Measurements were also available for the cold weather months from December through March for 1966-1967, 1967-1968, and 1968-1969. A summary of cold weather water quality measurements of parameters which violated the numerical water quality criteria are shown in Table 40 . Finally, the evaluations of trends in water quality are summarized in Tables 41 , 42 , 43 , and 44 . These estimated trends apply only to the available data for the time period in which measurements were made. As more water quality surveillance data is collected, the trends in water quality will be better defined. Although violations of water quality criteria were frequent and often severe, improvements in specific parameters show the effects of the pollution abatement program in the Calumet Area. Oil and grease and threshold odor show a trend of degraded water quality.

The analyses for heavy metals at Station 16 are summarized in Table 45 . No values for heavy metals are specified in the water quality criteria. However, the criteria specify that trace contaminants shall not be present in concentrations that will prevent meeting

Public Health Service 1962 Drinking Water Standards after conventional treatment. Measured values of heavy metals that exceed the criteria specified in the PHS 1962 criteria are marked with an asterisk in Table 45 . The heavy metal analyses were not considered in making the tabulation of violations of water quality criteria for which numerical values were specified or the evaluations of trends in water quality.

(a) Station 14 Gary West Water Plant Intake. Measurements were made on 29 parameters. Numerical criteria were specified for 18 parameters, and 14 of the criteria were violated during the sampling period. Ten of the measured parameters show an improvement in water quality. Thirteen parameters show no apparent change in water quality. Four parameters have insufficient data to indicate trends. Two pollutants which cause water treatment problems, threshold odor and oil and grease, show degradation in water quality. Also the plant nutrient, total phosphorous, show no apparent change.

(b) Station 15 East Chicago Water Plant Intake. Measurements were made on 29 parameters. Numerical criteria were specified for 17 parameters, and 11 of the criteria were violated during the sampling period. Fourteen of the measured parameters are estimated to show an improvement in water quality. Ten parameters show no apparent change in water quality. Four parameters have insufficient data to indicate trends. One pollutant which causes water treatment problems, oil and grease, shows a degradation in water quality. Also the plant nutrient, total phosphorous, shows no apparent change.

(c) Station 16 Hammond Water Plant Intake. Measurements were made on 29 parameters. Numerical criteria were specified for 17 parameters, and 12 of the criteria were violated during the sampling period. Eleven of the measured parameters show an improvement in water quality. Twelve parameters show no apparent change in water quality. Four parameters have insufficient data to estimate trends. One pollutant which causes water treatment problems, oil and grease, shows a degradation in water quality. Cyanide, which is little affected by conventional water treatment processes, also shows a degradation in water quality. Also the plant nutrient, total phosphorous, show no apparent change.

(d) Station 17 Chicago South Water Plant Intake. Measurements were made on 29 parameters. Numerical criteria were specified for 18 parameters, and 12 of the criteria were violated during the sampling period. Eleven of the measured parameters show an improvement in water quality. Twelve parameters show no apparent change in water quality. Four parameters have insufficient data to estimate trends. Two pollutants which cause water treatment problems, threshold odor and oil and grease, show a degradation in water quality. Also the plant nutrient, total phosphorous, shows no apparent change.

TABLE 35

SUMMARY OF WATER QUALITY MEASUREMENTS-AUGUST 1966 THROUGH JUNE 1969
STATION 14 GARY-WEST WATER PLANT INTAKE

Parameter	1966				1967				1968				1969				Criteria (1)		
	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	Max.	Min.	Mean
Coliform bact.,MPN/100ml	22	1,300	4	258	42	1,500	2	229	34	1,000	5	151	21	650	5	169	2,500	-	200
Fecal Strep,No./100ml	22	30	1	4	43	400	2	15	34	30	2	3	21	10	2	5	25	-	-
Turbidity,mg/l SiO_2	21	49	0.6	9.7	43	36	0	8.3	37	8.0	0	1.4	24	13.0	0.1	2.2	-	-	-
True Color,Pt-Co Units	21	20	0	4.5	41	7.0	0	1.8	38	8.0	0	1.0	25	7	0	1.6	15	-	5
Threshold Odor,Units	21	60	1.5	5.9	34	25	1.5	6.2	29	12	0	6.3	23	80	4.0	14.2	8	-	4
Water Temperature,°C	22	22	1	13.1	43	21	1	10.3	35	20	2	10.9	25	18	2	6.8	29.4	-	-
Oil & Grease,mg/l	20	4.8	0	1.0	42	4.0	0	.9	34	7.7	0	1.9	24	8.3	0	2.4	-	-	-
ph,Units	21	8.1	7.1	7.7	43	8.5	7.4	7.9	36	11.5	7.5	8.0	24	8.1	7.4	7.8	9.0	7.7	8.1-8.4mec
Dis. Oxygen,% Sat.	22	121.4	53.3	88.8	42	108.0	71.6	91.1	33	108.3	72.4	92.7	20	104	83	94	-	80	90
Ammonia N -N,mg/l	22	.28	.01	.07	43	.30	0	.09	37	.08	.01	.02	25	.50	.01	.09	.05	-	.02
Total N -N, mg/l	22	.95	.15	.51	43	1.13	.15	.56	37	.80	.17	.39	-	-	-	-	0.4	-	-
MBAS, mg/l	22	.13	.02	.06	43	.14	.01	.04	13	.09	0	.04	6	.11	.03	.07	.20	-	.05
Chlorides, mg/l	22	11	8	9.6	43	26	6	10.3	13	10	0	7.3	6	12	8	10.3	15	-	9
Cyanides, mg/l	22	.01	0	.0005	40	.01	0	.001	14	0	0	0	6	.01	0	.002	.025	-	-
Fluorides, mg/l	9	.40	.12	.20	11	.40	.17	.30	13	.42	0	.24	6	.38	.24	.30	1.3	-	1.0
Dis. Iron, mg/l	-	-	-	-	-	-	-	-	11	.150	0	.044	6	.350	0	.102	0.3	-	0.15
Phenols, mg/l	22	.005	0	.0015	43	.015	0	.0014	34	.004	0	.0006	24	.013	0	.003	.003	-	.001
Sulfates, mg/l	22	37	16	22.9	43	33	17	23.6	13	28	0	14.3	6	13	4	6.7	50	-	24
Total Phos-P,mg/l	22	.078	.007	.024	44	.068	.010	.025	37	.058	.006	.018	24	.111	.011	.027	.013	-	.010
Flt.Residue,mg/l	22	215	112	168	43	196	131	171	37	201	140	172	25	195	160	178	200	-	165
Fecal Coli.,No./100ml	21	130	2	18	42	1,000	2	77	34	75	5	9	21	86	2	15	-	-	-
Nonflt.Residue,mg/l	22	149	3	21.5	43	83	2	15.0	37	29	0	6.9	25	66	0	9.6	-	-	-
Dis.Oxygen, mg/l	22	14.8	4.9	9.6	42	14.5	6.8	10.6	36	13.6	2.6	10.3	-	-	-	-	-	-	-
Nitrate N-N,mg/l	22	.54	.05	.24	43	.62	.11	.26	37	.43	.10	.20	25	.33	.05	.17	-	-	-
Organic N-N, mg/l	21	.46	.01	.21	43	.50	.02	.22	37	.52	.02	.17	25	.60	.05	.27	-	-	-
BOD 5-day,mg/l	21	2.0	0.1	1.4	23	2.9	0.2	1.6	-	-	-	-	-	-	-	-	-	-	-
COD, mg/l	21	21	2	10.5	38	24	1	9.4	-	-	-	-	-	-	-	-	-	-	-
T Alk,mg/l $CaCO_3$	21	113	87	103.7	38	148	97	108.4	-	-	-	-	-	-	-	-	-	-	-
Cnductvy,umho/cm,25°C	21	325	260	295.5	43	335	240	276.5	37	300	250	270.3	25	330	249	283.3	-	-	-

TABLE 36

SUMMARY OF WATER QUALITY MEASUREMENTS-AUGUST 1966 THROUGH JUNE 1969
STATION 15 EAST CHICAGO WATER PLANT INTAKE

Parameter	1966				1967				1968				1969				Criteria		
	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	Max.	Min.	Mean
Coliform bact.,MPN/100ml	22	8,500	5	1,060	41	5,000	10	975	34	4,500	5	549	21	4,000	5	584	5,000	-	2,000
Fecal Strep,No./100ml	22	540	2	35	42	1,500	2	104	34	106	2	6	21	70	5	13	100	-	-
Turbidity,mg/l SiO_2	21	160.0	0.6	15.0	44	51.0	0	8.4	37	10.1	0	1.5	24	15.0	0.4	4.4	-	-	-
True Color,Pt-Co Units	21	30	0	5.8	43	5	0	2.1	36	4	0	0.9	25	5	0	1.4	15	-	5
Threshold Odor,Units	21	100.0	1.5	15.5	44	175.0	1.5	25.4	37	17.0	0	7.1	25	90.0	2.0	9.0	20	-	8
Water Temperature,°C	22	21	0	12.6	43	20	0	17.2	36	20	1	11.7	25	17	1	6.9	29.4	-	-
Oil & Grease,mg/l	20	4.2	0	.90	44	4.8	0	1.1	33	7.8	0	1.8	24	7.8	0	2.1	-	-	-
ph,Units	21	8.1	7.4	7.7	43	8.6	7.4	8.0	37	8.5	7.5	8.1	25	8.0	7.6	8.1	9.0	7.9	8.0-8.5 Desired
Dis.Oxygen,% Sat.	22	127.8	85.6	116.2	43	126.3	26.5	107.7	38	116.0	71.6	98.3	22	112	85	99	-	65	80
Ammonia N-N,mg/l	22	.40	.02	.14	44	.80	.02	.16	37	.56	.01	.07	25	.45	.02	.10	.12	-	.05
Total N-N,mg/l	22	1.06	.15	.62	44	1.77	.21	.71	37	1.21	.13	.49	-	-	-	-	-	-	-
MBAS, mg/l	22	.13	.04	.07	43	.16	.01	.05	12	.10	0	.05	6	.10	.04	.06	.30	-	.10
Chlorides, mg/l	22	13	8	10.0	43	19	6	10.9	12	15	0	8.3	6	15	8	11.0	30	-	18
Cyanides,mg/l	22	.02	0	.001	41	.02	0	.003	14	3.70	0	.266	6	.02	0	.004	0.1	-	-
Fluorides, mg/l	9	.28	.14	.20	31	.50	.16	.31	13	.36	0	.20	5	.88	.24	.48	1.3	-	1.0
Dis. Iron, mg/l	-	-	-	-	-	-	-	-	10	.110	0	.025	6	.310	0	.093	.30	-	.15
Phenols, mg/l	22	.007	0	.001	45	.016	0	.003	35	.010	0	.001	24	.012	0	.003	.005	-	.002
Sulfates, mg/l	22	36	16	24.9	43	35	18	24.8	12	32	0	14.7	6	15	3	7.8	75	-	36
Total Phos-P, mg/l	22	.320	.040	.039	44	.297	.010	.037	37	.074	.003	.020	24	.143	.009	.045	.033	-	.016
Flt.Residue, mg/l	22	211	77	165	44	200	149	173	37	204	135	173	25	207	158	179	230	-	190
Fecal Coli.,No./100ml	21	260	2	53	40	3,200	2	378	34	670	5	52	21	150	2	36	-	-	-
Nonflt.Residue,mg/l	22	464	2	38	44	378	1	21	37	39	1	8	25	79	0	15	-	-	-
Dis.Oxygen, mg/l	22	17.1	8.3	12.7	43	15.6	2.7	12.5	36	14.0	7.8	10.8	-	-	-	-	-	-	-
Nitrate N-N, mg/l	22	.60	0	.253	43	.50	.09	.254	37	.50	.09	.210	25	.34	.08	.172	-	-	-
Organic N-N, mg/l	20	1.19	.05	.290	44	1.10	.05	.293	37	.68	.02	.211	25	.70	.10	.24	-	-	-
BOD 5-day, mg/l	21	5.5	0.2	1.6	23	6.0	0.4	2.0	-	-	-	-	-	-	-	-	-	-	-
COD, mg/l	21	62	3	13.1	39	68	2	11.4	-	-	-	-	-	-	-	-	-	-	-
T Alk,mg/l $CaCO_3$	21	132	86	103.0	38	140	87	107.6	-	-	-	-	-	-	-	-	-	-	-
Cnductvy,umho/cm,25°C	21	360	275	307	44	350	245	280	37	305	250	273	25	330	255	288	-	-	-

TABLE 37
SUMMARY OF WATER QUALITY MEASUREMENTS-AUGUST 1966 THROUGH JUNE 1969
STATION 16 HAMMOND WATER PLANT INTAKE

Parameter	1966				1967				1968				1969				Criteria		
	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	Max.	Min.	Mean
Coliform bact.,MPN/100ml	22	19,000	110	2,047	41	170M	10	8,516	36	28,000	15	2,282	21	5,200	10	840	5,000	-	2,000
Fecal Strep.,No./100ml	21	7,600	2	443	41	50,000	2	1,519	36	1,500	5	79	21	660	2	52	100	-	-
Turbidity,mg/l SiO_2	21	180.0	0.6	17.6	43	38.0	0	8.8	39	10.5	0	2.2	23	12.0	0.1	2.0	-	-	-
True Color,Pt-Co Units	21	15	0	4.6	42	40	0	3.3	38	10	0	1.3	24	6	0	1.5	15	-	5
Threshold Odor,Units	21	150.0	3.5	34.1	43	800	4.0	59.0	38	80.0	6.0	33.7	24	100.0	3.0	28.9	20	-	8
Water Temperature,°C	22	22	0	13.0	44	27	0	10.6	38	26	1	12.8	24	18	0	6.7	29.4	-	-
Oil & Grease,mg/l	20	5.4	0	0.8	43	3.9	0	1.2	35	5.4	0	1.7	22	8.8	0	2.2	-	-	-
pH,Units	21	7.9	7.2	7.6	43	8.1	7.4	7.8	39	8.2	7.5	7.8	23	8.1	7.6	7.9	9.0	7.5	8.5
Dis. Oxygen, % Sat.	22	130.9	63.3	86.8	41	112.1	69.1	88.5	37	112.8	72.2	93.9	23	102	83	94	-	65	80
Ammonia N-N, mg/l	22	.38	.04	.15	44	.36	.02	.13	39	.60	.02	.09	24	.51	.02	.12	.12	-	.05
Total N-N, mg/l	22	1.10	.32	.75	44	1.71	.30	.70	39	1.15	.31	.53	-	-	-	-	-	-	-
MBAS, mg/l	22	.12	.03	.07	43	.20	.01	.06	14	.75	0	.09	8	.09	.04	.07	.30	-	.10
Chlorides, mg/l	22	13	9	10.3	43	20	6	10.9	14	12	0	8.2	8	12	9	10.2	30	-	18
Cyanides, mg/l	22	.01	0	.001	40	.01	0	.001	15	.04	0	.004	6	.01	0	.005	0.1	-	-
Fluorides, mg/l	9	.24	.16	.20	10	.46	.13	.30	13	.41	0	.22	8	.38	.19	.29	1.3	-	1.0
Dis. Iron, mg/l	-	-	-	-	-	-	-	-	11	.150	0	.023	8	.330	0	.095	.30	-	.15
Phenols, mg/l	22	.006	0	.002	44	.024	0	.003	36	.007	0	.001	23	.014	0	.003	.005	-	.002
Sulfates, mg/l	22	38	13	24.9	43	55	19	25.4	14	28	0	17.3	6	11	3	5.7	75	-	36
Total Phos.-P,mg/l	22	.104	.010	.032	44	.078	.013	.035	39	.075	.004	.029	23	.300	.007	.050	.033	-	.016
Flt.Residue,mg/l	22	275	87	167.5	43	217	151	172.2	39	195	149	173.9	24	208	161	179.8	230	-	190
Fecal Coli.,No/100ml	21	1,400	8	363	40	98,000	5	3,447	36	9,000	5	395	21	650	5	116	-	-	-
Nonflt.Residue,mg/l	22	202	2	30.6	43	71	2	15.2	39	55	1	13.6	24	124	0	26.3	-	-	-
Dis.Oxygen,mg/l	22	13.4	5.7	9.5	42	14.4	5.6	10.3	38	14.1	4.7	10.0	-	-	-	-	-	-	-
Nitrate N-N,mg/l	22	.76	.05	.32	43	.56	.10	.25	39	.60	.07	.21	24	.31	.06	.15	-	-	-
Organic N-N,mg/l	21	.73	.06	.29	44	1.30	.05	.33	39	.92	.02	.23	24	.80	.10	.32	-	-	-
BOD 5-day,mg/l	21	3.6	0.9	1.7	23	5.5	0.5	2.2	-	-	-	-	-	-	-	-	-	-	-
COD, mg/l	21	32	4	13.5	39	23	2	10.2	-	-	-	-	-	-	-	-	-	-	-
T Alk,mg/l $CaCO_3$	21	119	88	103	38	119	76	106	-	-	-	-	-	-	-	-	-	-	-
Cnductvy,umno/cm,25°C	21	330	275	303	43	345	245	285	39	300	230	276	24	350	251	292	-	-	-

TABLE 38

SUMMARY OF WATER QUALITY MEASUREMENTS-AUGUST 1966 THROUGH JUNE 1969
STATION 17 CHICAGO SOUTH WATER PLANT INTAKE

Parameter	1966				1967				1968				1969				Criteria		
	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	N	Max.	Min.	Mean	Max.	Min.	Mean
Coliform bact.,MPN/100 ml	22	135	2	27	41	900	2	91	35	270	2	33	14	130	4	29	2500	-	200
Fecal Strep., No./100 ml	22	10	1	3	42	40	2	4	35	34	2	5	19	20	2	4	25	-	-
Turbidity, mg/l SiO_2	21	160.0	0.6	13.6	42	44.0	0	7.2	38	10.5	0	1.6	22	16.5	0	4.2	-	-	-
True Color, Pt-Co Units	21	10	0	3.6	42	7	0	1.9	35	9	0	0.8	23	5	0	1.4	15	-	5
Threshold Odor, Units	19	35.0	2.5	8.4	40	50.0	1.5	6.6	35	47.0	1.0	6.0	21	19.0	3.0	4.2	8	-	4
Water Temperature, °C	22	23	3	14.7	42	21	4	12.6	35	28	3	14.0	23	18	5	8.9	29.4	-	-
Oil & Grease, mg/l	20	6.7	0	0.9	41	3.8	0	1.0	32	5.4	0	1.8	22	9.3	0	2.4	-	-	-
ph, Units	21	8.1	7.6	7.8	42	8.6	7.2	8.1	38	8.5	8.2	8.3	23	8.5	8.1	8.4	9.0	7.7	6.5-8.5
Dis.Oxygen, % Sat.	21	139.2	98.8	114.7	42	158.9	81.5	111.5	34	189.4	76.4	124.2	22	114	91	104	-	-	-
Ammonia N-N, mg/l	22	.23	.01	.06	42	.33	.01	.06	38	.18	.01	.04	23	.19	.01	.02	.05	-	.02
Total N-N, mg/l	22	1.08	.16	.47	42	1.37	.19	.56	38	1.14	.19	.42	-	-	-	-	0.4	-	-
MBAS, mg/l	22	.12	.02	.05	42	.17	0	.04	13	.08	0	.03	6	.08	.04	.07	.20	-	.05
Chlorides, mg/l	22	12	8	9.3	42	17	6	9.8	13	11	0	7.5	6	12	9	9.5	15	-	9
Cyanides, mg/l	22	.01	0	.0005	40	.01	0	.0005	14	.01	0	.0007	6	0	0	0	.025	-	-
Fluorides, mg/l	9	.30	.16	.21	10	.50	.04	.29	12	.39	.14	.26	6	.35	.19	.27	1.3	-	1.0
Dis. Iron, mg/l	-	-	-	-	-	-	-	-	11	.260	0	.052	6	.340	0	.107	.30	-	.15
Phenols, mg/l	22	.003	0	.0006	42	.009	0	.0015	36	.005	0	.0009	22	.013	0	.002	.003	-	.001
Sulfates, mg/l	22	32	13	22.0	42	30	17	22.8	13	27	0	14.3	6	10	3	5.8	50	-	24
Total Phos-P, mg/l	22	.068	.006	.020	44	.052	.006	.022	38	.090	.003	.018	22	.092	.009	.026	.013	-	.010
Filt.Residue, mg/l	22	196	37	157.6	41	205	144	170.3	37	201	149	176.0	23	205	158	184.4	200	-	165
Fecal Coli., No./100ml	20	20	2	6	41	200	2	24	35	38	2	5	19	6	2	3	-	-	-
Nonflt.Residue, mg/l	22	135	1	17	41	58	1	11	38	28	1	5	23	62	0	9	-	-	-
Dis.Oxygen, mg/l	21	16.3	6.1	12.2	42	15.6	7.5	12.1	37	17.8	8.1	13.0	-	-	-	-	-	-	-
Nitrate N-N, mg/l	22	.67	.05	.22	42	.92	.06	.23	38	.65	.03	.21	23	.29	.04	.12	-	-	-
Organic N-N, mg/l	22	.33	.02	.19	42	.74	.06	.27	38	.74	0	.18	23	.40	.10	.27	-	-	-
BOD 5-day, mg/l	20	1.6	0.2	0.9	23	3.0	0.2	1.4	-	-	-	-	-	-	-	-	-	-	-
COD, mg/l	21	18	2	9.6	37	25	2	8.5	-	-	-	-	-	-	-	-	-	-	-
T Alk, mg/l $CaCO_3$	21	114	88	103	37	174	93	110	-	-	-	-	-	-	-	-	-	-	-
Cnductvy, umho/cm,25°C	21	330	260	292	42	350	245	279	37	290	240	269	23	340	248	284	-	-	-

(1) Criteria for Station 14 is Indiana Regulation SPC 4, Lake Michigan Open Water
Criteria for Station 15 is Indiana Regulation SPC 6, Lake Michigan Inner Harbor Basin
Criteria for Station 16 is Indiana Regulation SPC 6, Lake Michigan Inner Harbor Basin
Criteria for Station 17 is Illinois Rules and Regulations SWB7-Rule 1.01, Lake Michigan Open Water
Criteria listed are those criteria for which numerical values are specified.
Criteria for ph units are expressed as medians.

N - Number of samples
(-) Not applicable or no data available

TABLE 39
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria 1966 Aug-Dec	1967	1968	1969 Jan-June	Violations of Daily Criteria 1966 Aug-Dec	1967	1968	1969 Jan-June
STATION 14 GARY-WEST WATER PLANT INTAKE									
Coliform Bacteria MPN/100 ml	Annual Avg. ≤200 Single Day ≤ 2,500	258	229	-	-(2)	0/22 (3)	0/42	0/34	0/21
Fecal Streptococci Number/100 ml	Single Day ≤ 25					1/22	4/43	1/34	0/21
True Color Units	Annual Avg. ≤5 Single Day ≤15	-	-	-	-	1/21	0/41	0/38	0/25
Threshold Odor Units	Annual Avg. ≤4 Single Day ≤8	6	6	6	14	1/21	4/34	3/29	5/8
Temperature, °F	Single Day ≤85					0/22	0/43	0/35	0/25
pH, Units	Annual Median 8.1-8.4 (2) Daily Median 7.7-9.0	7.7	7.9	8.0	7.8	8/21	5/43	4/36	/24
Dissolved Oxygen Percent Saturation	Annual Avg. ≥90 Single Day ≥80	88.8	-	-	-	7/22	8/42	2/36	0/10 (Jan-Mar)
Ammonia Nitrogen(N) mg/l	Annual Avg. ≤.02 Single Day ≤.05	.07	.09	-	.09	11/22	19/43	3/37	11/25
Total Nitrogen (N) mg/l	Single Day ≤.40					17/22	34/43	13/37	11/12 (Jan-Mar)
Methylene Blue Active Substance (MBAS), mg/l	Annual Avg. ≤.05 Single Day ≤.20	.06	-	-	.07	0/22	0/43	0/13	0/6
Chlorides (Cl) mg/l	Annual Avg. ≤ 9 Single Day ≤15	10	10	-	10	0/22	1/43	0/13	0/6

TABLE 39 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria 1966 Aug-Dec	1967	1968	1969 Jan-June	Violations of Daily Criteria 1966 Aug-Dec	1967	1968	1969 Jan-June
	STATION 14 GARY-WEST WATER PLANT INTAKE (Continued)								
Cyanides (CN) mg/l	Single Day ≤.025					0/22	0/40	0/14	0/9
Fluorides (F) mg/l	Annual Avg. ≤1.0 Single Day ≤1.3	-	-	-	-	0/9	0/11	0/13	0/5
Dissolved Iron (Fe) mg/l	Annual Avg. ≤.15 Single Day ≤.30	NA(4)	NA	-	-	NA	NA	0/11	1/9
Phenol-like Substances, mg/l	Annual Avg. ≤.001 Single Day ≤.003	.0015	.0014	-	.0025	3/22	5/43	1/34	8/24
Sulfates (SO_4) mg/l	Annual Avg. ≤24 Single Day ≤90	-	-	-	-	0/22	0/43	0/13	0/9
Total Phosphates (P), mg/l	Annual Avg. ≤.010 Single Day ≤.015	NA	.025	.018	.027	NA	5/5	24/37	19/24
Filterable Residue mg/l	Annual Avg. ≤165 Single Day ≤200	165	171	172	178	1/22	0/43	1/37	0/25
	STATION 15 EAST CHICAGO WATER PLANT INTAKE								
Coliform Bacteria MPN/100 ml	Annual Avg. ≤2,000 Single Day ≤5,000	-	-	-	-	2/22	0/41	0/34	0/21
Fecal Streptococci Number/100 ml	Single Day ≤100	-	104	-	-	1/22	6/42	1/34	0/21
True Color Units	Annual Avg. ≤5 Single Day ≤15	0	-	-	-	1/21	0/43	0/36	0/25

TABLE 39(Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966 Aug-Dec	1967	1968	1969 Jan-June	1966 Aug-Dec	1967	1968	1969 Jan-June
STATION 15 EAST CHICAGO WATER PLANT INTAKE (Continued)									
Threshold Odor Units	Annual Avg. ≤ 8 Single Day ≤ 20	16	25	-	9	2/21	11/44	0/37	1/25
Temperature, °F	Single Day ≤ 85					0/22	0/43	0/36	0/25
pH, Units	Annual Median 8.0-8.5 (2) Daily Median 7.5-9.0	7.7	-	-	-	1/21	2/43	0/37	0/25
Dissolved Oxygen Percent Saturation	Annual Avg. ≥ 80 Single Day ≥ 65	-	-	-	-	0/22	2/43	0/35	0/12 (Jan-Mar)
Ammonia Nitrogen (N) mg/l	Annual Avg. ≤ .05 Single Day ≤ .12	.14	.16	.07	.16	11/22	18/44	3/37	12/25
Methylene Blue Active Substance(MBAS), mg/l	Annual Avg. ≤ .10 Single Day ≤ .30	-	-	-	-	0/22	0/43	0/12	0/6
Chlorides (Cl) mg/l	Annual Avg. ≤ 18 Single Day ≤ 30	-	-	-	-	0/22	0/43	0/12	0/6
Cyanides (CN) mg/l	Single Day ≤ .10					0/22	0/41	1/14	0/6
Fluorides (F) mg/l	Annual Avg. ≤ 1.0 Single Day ≤ 1.3	-	-	-	-	0/9	0/11	0/13	0/6
Dissolved Iron (Fe) mg/l	Annual Avg. ≤ .15 Single Day ≤ .30	NA	NA	-	-	NA	NA	0/10	1/6
Phenol-like Substances, mg/l	Annual Avg. ≤ .002 Single Day ≤ .005	-	.0029	-	.0032	1/22	8/45	1/35	5/24

TABLE 39 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966 Aug-Dec	1967	1968	1969 Jan-June	1966 Aug-Dec	1967	1968	1969 Jan-June
	STATION 15 EAST CHICAGO WATER PLANT INTAKE (Continued)								
Sulfates (SO_4) mg/l	Annual Avg. ≤ 36 Single Day ≤ 75	-	-	-	-	0/22	0/43	0/12	0/6
Total Phosphates (P), mg/l	Annual Avg. ≤ .016 Single Day ≤ .033	NA	.042	.020	.045	NA	3/6	3/37	10/24
Filterable Residue mg/l	Annual Avg. ≤ 190 Single Day ≤ 230	-	-	-	-	0/22	0/44	0/37	0/25
	STATION 16 HAMMOND WATER PLANT INTAKE								
Coliform Bacteria MPN/100 ml	Annual Avg. ≤2,000 Single Day ≤5,000	2,047	8,516	2,281	-	2/22	5/41	2/36	1/21
Fecal Streptococci Number/100 ml	Single Day ≤100					3/21	12/41	4/36	1/21
True Color Units	Annual Avg. ≤ 5 Single Day ≤ 15	-	-	-	-	0/21	1/42	0/38	0/24
Threshold Odor Units	Annual Avg. ≤ 8 Single Day ≤ 20	34	59	34	29	9/21	34/43	28/38	6/24
Temperature, °F	Single Day ≤85					0/22	0/44	0/38	0/24
pH, Units	Annual Median 8.0-8.5 (2) Daily Median 7.5-9.0	7.6	7.8	7.8	7.9	4/21	1/43	0/39	0/23
Dissolved Oxygen Percent Saturation	Annual Avg. ≥ 80 Single Day ≥ 65	-	-	-	-	1/22	0/41	0/37	0/12 (Jan-Mar)

TABLE 39 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966 Aug-Dec	1967	1968	1969 Jan-June	1966 Aug-Dec	1967	1968	1969 Jan-June
	STATION 16 HAMMOND WATER PLANT INTAKE (Continued)								
Ammonia Nitrogen (N) mg/l	Annual Avg. ≤.05 Single Day ≤.12	.15	.13	.08	.12	14/22	23/44	6/39	7/12
Methylene Blue Active Substance (MBAS), mg/l	Annual Avg. ≤.10 Single Day ≤.30	-	-	-	-	0/22	0/43	1/14	0/6
Chlorides (Cl) mg/l	Annual Avg. ≤18 Single Day ≤30	-	-	-	-	0/22	0/43	0/14	0/6
Cyanides (CN) mg/l	Single Day ≤.10					0/22	0/40	0/15	0/6
Fluorides (F) mg/l	Annual Avg. ≤1.0 Single Day ≤1.3	-	-	-	-	0/9	0/10	0/13	0/6
Dissolved Iron (Fe) mg/l	Annual Avg. ≤.15 Single Day ≤.30	NA	NA	-	-	NA	NA	0/11	1/6
Phenol-like Substances, mg/l	Annual Avg. ≤.002 Single Day ≤.005	-	.003	-	.003	1/22	6/44	2/36	6/23
Sulfates (SO_4) mg/l	Annual Avg. ≤36 Single Day ≤75	-	-	-	-	0/22	0/43	0/14	0/6
Total Phosphates (P), mg/l	Annual Avg. ≤.016 Single Day ≤.033	NA	.062	.029	.050	NA	9/10	10/39	6/23
Filterable Residue mg/l	Annual Avg. ≤190 Single Day ≤230	-	-	-	-	1/22	0/43	0/39	0/24

TABLE 39 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966 Aug-Dec	1967	1968	1969 Jan-June	1966 Aug-Dec	1967	1968	1969 Jan-June
	STATION 17 CHICAGO SOUTH WATER PLANT INTAKE								
Coliform Bacteria MPN/100 ml	Annual Avg. ≤ 200 Single Day ≤ 2,500	-	-	-	-	0/22	0/41	0/35	0/19
Fecal Streptococci Number/100 ml	Single Day ≤ 25					0/22	2/42	1/35	0/19
True Color Units	Annual Avg. ≤ 5 Single Day ≤ 15	-	-	-	-	0/21	0/42	0/35	0/23
Threshold Odor Units	Annual Avg. ≤ 4 Single Day ≤ 8	8.4	6.6	6.0	4.2	4/19	4/40	2/35	1/21
Temperature, °F	Single Day ≤ 85					0/22	0/42	0/35	0/23
pH, Units	Annual Median 8.1-8.4 (2) Daily Median 7.7-9.0	7.8	-	-	-	3/21	7/42	0/36	0/23
Dissolved Oxygen Percent Saturation	Annual Avg. ≥ 90 Single Day ≥ 80	-	-	-	-	1/21	0/42	1/37	0/10 (Jan-Mar)
Ammonia Nitrogen (N) mg/l	Annual Avg. ≤ .02 Single Day ≤ .05	.06	.06	.04	.05	8/22	11/42	6/38	5/23
Total Nitrogen (N) mg/l	Single Day ≤ .40					11/22	29/42	16/38	5/13 (Jan-Mar)
Methylene Blue Active Substance(MBAS), mg/l	Annual Avg. ≤ .05 Single Day ≤ .20	-	-	-	.07	0/22	0/42	0/13	0/6
Chlorides (Cl) mg/l	Annual Avg. ≤ 9 Single Day ≤ 15	9.3	9.8	-	9.5	0/22	1/42	0/13	0/6

TABLE 39 (Continued)
SUMMARY OF VIOLATIONS OF WATER QUALITY CRITERIA
AUGUST 1966 THROUGH JUNE 1969

Parameter	Criteria (1)	Violations of Annual Criteria				Violations of Daily Criteria			
		1966 Aug-Dec	1967	1968	1969 Jan-June	1966 Aug-Dec	1967	1968	1969 Jan-June
	STATION 17 CHICAGO SOUTH WATER PLANT INTAKE (Continued)								
Cyanides (CN) mg/l	Single Day ≤ .025					0/22	0/40	0/14	0/6
Fluorides (F) mg/l	Annual Avg. ≤ 1.0 Single Day ≤ 1.3	-	-	-	-	0/9	0/10	0/12	0/6
Dissolved Iron (Fe) mg/l	Annual Avg. ≤ .15 Single Day ≤ .30	NA	NA	-	-	NA	NA	0/11	1/6
Phenol-like Substances, mg/l	Annual Avg. ≤ .001 Single Day ≤ .003	-	.0015	-	-	0/22	4/42	3/36	3/22
Sulfates (SO_4) mg/l	Annual Avg. ≤ 24 Single Day ≤ 50	-	-	-	-	0/22	0/42	0/13	0/6
Total Phosphates (P), mg/l	Annual Avg. ≤ .010 Single Day ≤ .013	NA	.022	.018	.025	NA	5/5	23/38	17/22
Filterable Residue mg/l	Annual Avg. ≤ 165 Single Day ≤ 200	-	170	176	179	0/22	2/41	1/37	3/23

(1) Criteria for Station 14 is Indiana Regulation SPC 4, Lake Michigan Open Water.
Criteria for Station 15 is Indiana Regulation SPC 6, Lake Michigan Inner Harbor Basin.
Criteria for Station 16 is Indiana Regulation SPC 6, Lake Michigan Inner Harbor Basin.
Criteria for Station 17 is Illinois Rules and Regulations SWB 7-Rule 1.01, Lake Michigan Open Water.
Criteria listed are those criteria for which numerical values are specified.
Criteria for pH units are expressed as medians, but evaluation of compliance was based on averages.
(2) -= Criteria not exceeded.
(3) 0/22 = number of days criteria exceeded/number of days measurements were made.
(4) NA = No measurements available.

TABLE 40

SUMMARY OF COLD WEATHER WATER QUALITY MEASUREMENTS (DECEMBER THROUGH MARCH) OF PARAMETERS WHICH VIOLATED WATER QUALITY CRITERIA
WATER QUALITY MONITORING STATIONS 14, 15, 16, AND 17

Parameter	1966-1967				1967-1968				1968-1969			
	N	Max.	Min.	Avg.	N	Max.	Min.	Avg.	N	Max.	Min.	Avg.
STATION 14 GARY-WEST WATER PLANT INTAKE												
Temperature (for reference)	17	5	1	2	5	6	2	4	14	6	2	3
Coliform bact. MPN/100 ml	16	1,500	5	205	5	100	5	24	14	1,000	5	192
Fecal Strep., No./100 ml	17	400	2	36	5	30	2	8	14	14	2	6
True Color, Pt-Co Units	17	7	0	2.3	5	8	0	3.6	15	2	0	0.4
Threshold Odor, Units	16	60	1.5	9.7	4	6	6	6	14	80	6	16
pH, Units	7	8.3	7.4	7.7	5	8.2	8.0	8.1	15	8.1	7.4	7.8
Dis. Oxygen, % Sat.	17	117.6	91.9	99.0	5	104.7	96.0	99.1	11	103.0	91.3	96.1
Ammonia Nitrogen-N, mg/l	17	.28	.03	.12	5	.08	.01	.03	15	.50	.01	.13
Total Nitrogen-N, mg/l	17	.95	.26	.62	5	.59	.33	.48	15	.91	.30	.55
MBAS, mg/l	17	.14	.03	.07	4	.09	.02	.06	4	.11	.05	.08
Chlorides-Cl, mg/l	17	15	8	10.7	4	10	7	8.5	4	12	9	10.8
Phenol-like substances, mg/l	17	.005	0	.002	4	.015	0	.004	15	.005	0	.002
Total Phosphate-P, mg/l	-	-	-	-	5	.060	.014	.030	15	.111	.006	.027
Flt. Residue (total dis. solids), mg/l	17	215	155	177	5	197	159	178	15	192	140	172
STATION 15 EAST CHICAGO WATER PLANT INTAKE												
Temperature (for reference)	17	5	0	2	4	8	1	5	15	7	1	3
Coliform bact., MPN/100 ml	16	5,000	10	1,176	4	2,500	5	724	14	4,500	5	500
Fecal Strep., No./100 ml	17	1,500	5	252	4	120	2	34	14	106	5	24
True Color, Units	17	5	0	3.5	4	3	0	1.5	15	3	0	0.7
Threshold Odor, Units	17	175	2.5	58	4	17	6	10.8	15	12	4.2	8.6
pH, Units	17	8.1	7.4	7.6	4	8.2	7.8	8.1	15	8.6	7.8	8.1
Dis.Oxygen, % Sat.	17	120.3	100.7	110.9	4	106.1	92.8	97.6	15	108.0	87.5	98.6
Ammonia Nitrogen-N, mg/l	18	.80	.03	.30	4	.38	.03	.17	15	.56	.04	.22
Cyanides-CN, mg/l	17	.02	0	.008	3	.01	0	.007	5	.02	0	.010
Phenol-like substances, mg/l	18	.016	0	.004	3	.004	.002	.003	15	.009	0	.003
Total Phosphate-P, mg/l	-	-	-	-	4	.060	.010	.040	15	.132	.010	.038

TABLE 40 (Continued)
SUMMARY OF COLD WEATHER WATER QUALITY MEASUREMENTS (DECEMBER THROUGH MARCH) OF
PARAMETERS WHICH VIOLATED WATER QUALITY CRITERIA
WATER QUALITY MONITORING STATIONS 14, 15, 16, AND 17

Parameter	1966-1967				1967-1968				1968-1969			
	N	Max.	Min.	Avg.	N	Max.	Min.	Avg.	N	Max.	Min.	Avg.
STATION 16 HAMMOND WATER PLANT INTAKE												
Temperature (for reference)	18	5	0	1	5	7	1	4	15	6	0	3
Coliform bact., MPN/100 ml	15	20,000	60	3,350	5	430	15	205	15	3,000	10	719
Fecal Strep., No./100 ml	15	50,000	10	4,078	5	260	5	66	15	660	5	56
True Color, Units	17	40	0	6.2	5	10	0	5.4	15	2	0	.13
Threshold Odor, Units	17	800	5	91	5	40	20	32	15	100	3	34
pH, Units	17	8.0	7.2	7.7	5	8.1	7.7	7.9	14	8.1	7.6	7.8
Dis. Oxygen, % Sat.	17	112.1	85.6	94.5	5	101.2	96.7	99.0	15	103.6	91.1	97.1
Ammonia Nitrogen-N, mg/l	18	.27	.03	.16	5	.15	.02	.08	15	.60	.02	.17
MBAS, mg/l	17	.20	.03	.090	4	.75	.02	.210	4	.09	.06	.075
Phenol-like substances, mg/l	18	.018	0	.003	4	.008	0	.003	15	.011	0	.003
Total Phosphate-P, mg/l	-	-	-	-	5	.069	.019	.043	15	.238	.007	.040
Flt. Residue (total dis.solids), mg/l	17	275	154	179	5	195	164	179	15	204	157	177
STATION 17 CHICAGO SOUTH WATER PLANT INTAKE												
Temperature (for reference)	17	7	3	5	4	7	3	5	13	8	3	6
Fecal Strep., No./100 ml	17	40	2	7	5	2	2	2	13	4	2	2
Threshold Odor, Units	16	9.0	1.5	3.6	5	27.0	4.0	8.6	11	10.0	3.0	4.4
pH, Units	17	8.5	7.2	7.7	5	8.4	8.3	8.3	13	8.5	8.1	8.3
Dis. Oxygen, % Sat.	17	127.3	103.8	114.5	4	142.6	106.7	118.3	13	115.2	100.4	109.4
Ammonia Nitrogen-N, mg/l	17	.33	.01	.08	5	.04	.01	.02	13	.19	.01	.05
Total Nitrogen-N, mg/l	17	1.37	.24	.60	5	.75	.27	.46	13	.69	.22	.42
Chlorides-Cl, mg/l	17	15	8	10	4	11	5	8	4	9	9	9
Phenol-like substances, mg/l	17	.008	0	.001	4	.002	0	.001	13	.003	0	.001
Total Phosphate-P, mg/l	-	-	-	-	5	.035	.011	.022	13	.042	.010	.023
Flt. Residue (total dis. solids), mg/l	17	196	145	172	5	180	160	173	13	190	149	173

N - Number of samples.

TABLE 41

STATION 14 GARY-WEST WATER PLANT INTAKE
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY (1)
August 1966 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Coliform bact., MPN/100 ml **	X		
Fecal Strep., No./100 ml **	X		
Turbidity, mg/l SiO_2	X		
True Color, Pt-Co Units **	X		
Threshold Odor, Units **		X	
Water Temperature, °C *			X
Oil & Grease, mg/l		X	
pH, Units **	X		
Diss. Oxygen, % Sat. **			X
Ammonia N-N, mg/l **			X
Total N-N, mg/l **	X		
MBAS, mg/l **			X
Chlorides, mg/l **			X
Cyanides, mg/l *			X
Fluorides, mg/l *			X
Diss. Iron, mg/l **	-	-	-
Phenols, mg/l **			X
Sulfates, mg/l *	X		
Total Phos.-P, mg/l **			X
Filt. Residue, mg/l **			X
Fecal Coli., No./100 ml	X		
Nonfilt. Residue, mg/l	X		
Diss. Oxygen, mg/l			X
Nitrate N-N, mg/l	X		
Organic N-N, mg/l			X
BOD 5-day, mg/l	-	-	-
COD, mg/l	-	-	-
Total Alk., mg/l $CaCO_3$	-	-	-
Conductivity, umho/cm, 25°C			X

(1) Estimates of trends in water quality were based on sampling data from comparable sampling periods, generally the complete years of 1967 and 1968 (Table 35) and, for parameters which violated the numerical criteria, the cold weather measurements of 1966-1967, 1967-1968, and 1968-1969 (Table 40)

- \- No data or insufficient data
- * Parameter included in water quality criteria
- ** Parameter included in water quality criteria and water quality criteria violated

TABLE 42
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY (1)
STATION 15 EAST CHICAGO WATER PLANT INTAKE
August 1966 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Coliform bact., MPN/100 ml **	X		
Fecal Strep., No./100 ml **	X		
Turbidity, mg/l SiO_2	X		
True Color, Pt-Co Units **	X		
Threshold Odor, Units **	X		
Water Temperature, °C *			X
Oil & Grease, mg/l		X	
pH, Units **	X		
Diss. Oxygen, % Sat. **			X
Ammonia N-H, mg/l **	X		
Total N-H, mg/l	X		
MBAS, mg/l *			X
Chlorides, mg/l *			X
Cyanides, mg/l **			X
Fluorides, mg/l *			X
Diss. Iron, mg/l **	-	-	-
Phenols, mg/l **	X		
Sulfates, mg/l *	X		
Total Phos.-P, mg/l **			X
Filt. Residue, mg/l *			X
Fecal Coli., No./100 ml	X		
Nonfilt. Residue, mg/l	X		
Diss. Oxygen, mg/l			X
Nitrate N-H, mg/l	X		
Organic N-H, mg/l	X		
BOD 5-day, mg/l	-	-	-
COD, mg/l	-	-	-
Total Alk., mg/l $CaCO_3$	-	-	-
Conductivity, umho/cm, 25°C			X

(1) Estimates of trends in water quality were based on sampling data from comparable sampling periods, generally the complete years of 1967 and 1968 (Table 36) and, for parameters which violated the numerical criteria, the cold weather measurements of 1966-1967, 1967-1968, and 1968-1969 (Table 40)

- No data or insufficient data
- * Parameter included in water quality criteria
- ** Parameter included in water quality criteria and water quality criteria violated

TABLE 43

STATION 16 HAMMOND WATER PLANT INTAKE
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY (1)
August 1966 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Coliform bact., MPN/100 ml **	X		
Fecal Strep., No./100 ml **	X		
Turbidity, mg/l SiO_2	X		
True Color, Pt-Co Units **	X		
Threshold Odor, Units **	X		
Water Temperature, °C *			X
Oil & Grease, mg/l		X	
pH, Units **	X		
Diss. Oxygen, % Sat. **			X
Ammonia N-N, mg/l **			X
Total N-N, mg/l	X		
MBAS, mg/l **			X
Chlorides, mg/l *			X
Cyanides, mg/l *		X	
Fluorides, mg/l *			X
Diss. Iron, mg/l **	-	-	-
Phenols, mg/l **			-
Sulfates, mg/l *	X		
Total Phos.-P, mg/l **			X
Filt. Residue, mg/l **			X
Fecal Coli., No./100 ml	X		
Nonfilt. Residue, mg/l	X		
Diss. Oxygen, mg/l			X
Nitrate N-N, mg/l	X		
Organic N-N, mg/l			X
BOD 5-day, mg/l	-	-	-
COD, mg/l	-	-	-
Total Alk., mg/l $CaCO_3$	-	-	-
Conductivity, umho/cm, 25°C			X

(1) Estimates of trends in water quality were based on sampling data from comparable sampling periods, generally the complete years of 1967 and 1968 (Table 37) and, for parameters which violated the numerical criteria, the cold weather measurements of 1966-1967, 1967-1968, and 1968-1969 (Table 40)

- \- No data or insufficient data
- * Parameter included in water quality criteria
- ** Parameter included in water quality criteria and water quality criteria violated

TABLE 44

STATION 17 CHICAGO SOUTH WATER PLANT INTAKE
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY (1)
August 1966 - June 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
Coliform bact., MPN/100 ml *	X		
Fecal Strep., No./100 ml **.....	X		
Turbidity, mg/l SiO_2	X		
True Color, Pt-Co Units *	X		
Threshold Odor, Units **.....		X	
Water Temperature,°C *			X
Oil & Grease, mg/l		X	
pH, Units **	X		
Diss. Oxygen, % Sat. **			X
Ammonia N-N, mg/l **	X		
Total N-N, mg/l **.....	X		
MBAS, mg/l **			X
Chlorides, mg/l **.....	X		
Cyanides, mg/l *			X
Fluorides, mg/l *			X
Diss. Iron, mg/l **	-	-	-
Phenols, mg/l **			X
Sulfates, mg/l *	X		
Total Phos.-P, mg/l **			X
Filt. Residue, mg/l **			X
Fecal Coli., No./100 ml	X		
Nonfilt. Residue, mg/l	X		
Diss. Oxygen, mg/l			X
Nitrate N-N, mg/l			X
Organic N-N, mg/l			X
BOD 5-day, mg/l	-	-	-
COD, mg/l	-	-	-
Total Alk., mg/l $CaCO_3$	-	-	-
Conductivity, umho/cm, 25°C			X

(1) Estimates of trends in water quality were based on sampling data from comparable sampling periods, generally the complete years of 1967 and 1968 (Table 38) and, or parameters which violated the numerical criteria, the cold weather measurements of 1966-1967, 1967-1968, and 1968-1969 (Table 40)

\- No data or insufficient data

* Parameter included in water quality criteria

** Parameter included in water quality criteria and water quality criteria violated

TABLE 45

SUMMARY OF HEAVY METAL MEASUREMENTS
WATER QUALITY MONITORING STATION 16 HAMMOND WATER PLANT INTAKE
AUGUST 1966 THROUGH JUNE 1969

Parameter	1966 N	1966 Max	1966 Min	1966 Mean	1967 N	1967 Max	1967 Min	1967 Mean	1968 N	1968 Max	1968 Min	1968 Mean	1969 N	1969 Max	1969 Min	1969 Mean
(some composites)																
Cadmium-Cd, mg/l "	1	-	-	0.0	3	0.0	0.0	0.0	12	0.020*	0.0	0.003	6	.002	0.0	.0003
Copper-Cu, mg/l "	1	-	-	0.0	3	0.0	0.0	0.0	12	0.060	0.0	0.010	6	.026	.012	.018
Potassium-K, mg/l "	2	1.7	1.5	1.6	3	1.6	1.4	1.5	11	1.8	1.3	1.6	6	5.7	1.4	2.4
Chromium-Cr, mg/l "	1	-	-	0.0	3	0.020	0.0	0.010	12	0.040	0.0	0.006	6	.015	0.0	.006
Manganese-Mn, mg/l "	1	-	-	0.020	3	0.050	0.0	0.017	12	0.084*	0.0	0.039	6	.075*	.036	.055*
Lead-Pb, mg/l "	1	-	-	0.0	3	0.040	0.0	0.020	12	0.060*	0.0	0.018	6	.025	0.0	.006
Nickel-Ni, mg/l "	1	-	-	0.0	3	0.050	0.0	0.030	11	0.047	0.0	0.015	6	.032	0.0	.011
Arsenic-As, mg/l "	2	0.0	0.0	0.0	3	0.092*	0.0	0.037	10	0.097*	0.0	0.030	6	.114*	0.0	.029
Zinc-Zn, mg/l "	1	-	-	0.030	3	0.050	0.030	0.040	12	0.102	0.0	0.037	6	.079	.023	.049
Sodium-Na, mg/l "	2	5.8	5.3	5.6	3	5.3	3.5	4.5	11	6.1	4.6	5.2	6	23.0	1.5	8.0

N - Number of samples.
* - Values that exceed the following PHS 1962 Drinking Water Standards: Cadmium-Cd, mg/l $\leq$ .01 for rejection of supply; Manganese-Mn, mg/l $\leq$ .05 if more suitable supplies are available; Lead-Pb, mg/l $\leq$ .05 for rejection of supply; Arsenic-As, mg/l $\leq$ .05 for rejection of supply.

Calumet River - Lake Side of O'Brien Locks. Samples were taken at the following stations for the period 1967, 1968, and 1969.

1) Calumet River at Ewing Avenue

2) Calumet River at Torrence Avenue

3) Calumet River at 130th Street

Ammonia nitrogen values exceeded the criteria at the Torrence Avenue Station in 1969 for five out of the samples taken in this period. At Ewing Avenue and 130th Street the ammonia nitrogen concentrations have improved since 1967 and now meet the criteria of 2.5 mg/l (SWB-15, Rule 1.07 - 10c).

There were no violations of bacterial quality criteria at Ewing Avenue and 130th Street Stations. The data for Torrence Avenue Station shows an apparent degradation for total coliform, fecal coliform, and fecal streptococci. The fecal coliform criteria was violated at this Station.

The values for cyanides, hexane solubles, and dissolved iron have remained at about the same levels. There are no criteria for cyanide, dissolved iron, and hexane solubles. During the evaluation period, visible oil and debris were frequently observed at all three stations in violation of SWB-15.

There was no apparent improvement in phenol concentrations at 130th Street and Torrence Avenue, and there was apparent degradation at Ewing Avenue. Maximum values noted during 1969 indicated that slugs of phenols were being discharged to the river. There is no stream criteria for phenols. The temperature and pH values were within criteria limits. A summary of water quality measurements and an evaluation of trends in water quality are shown in Tables 46 and 47.

TABLE 46

SUMMARY OF WATER QUALITY MEASUREMENTS - CALUMET RIVER

(Data from Samples Collected by Metropolitan Sanitary District and State of Illinois)

Parameter	1967 N	1967 Max	1967 Min	1967 Mean	1968 N	1968 Max	1968 Min	1968 Mean	1969 N	1969 Max	1969 Min	1969 Mean	Criteria (1)
CALUMET RIVER AT EWING AVENUE													
Ammonia N-N mg/l	14	2.65	.01	.99	4	1.5	.01	.75	16	1.2	0.0	.37	(2) ≤ 2.5 mg/l
Oil & Grease mg/l	15	42	2	12	3	6	2	4.3	3	50	7	24	
Phenols ug/l	15	79	2	17	4	16	0	5	14	14,000(3)	0	38	
Cyanides mg/l	12	.0632	.0008	.0159	3	.001	.0000	.0003	14	.000	.0000	.0150	
Iron mg/l	12	1.90	.08	1.47	4	2.10	0.00	1.05	14	2.20	0.00	.65	
Coli.bact.MPN/100ml	15	7700	10	430(4)	3	2100	200	749(4)	6	2000	400	930(4)	
Fec.Coli.MPN/100ml	15	240	10	47(4)	3	400	200	252(4)	16	600	10	128(4)	(4) ≤ 1000/100ml
Fec.Strep.MPN/100ml	15	210,100	10	160(4)	3	1800	100	600(4)	8	700	100	155(4)	
Water Temp. °C	15	14.4	1.1	8.9	5	23.3	16.7	20.0	13	23.3	1.1	14.4	≤ 33.9°C
pH Units	15	8.4	6.6	7.6	4	8.3	7.2	7.7	16	8.7	7.0	7.9	6.0 - 9.0
CALUMET RIVER AT 130TH AVENUE													
Ammonia N-N mg/l	30	8.20	.90	2.56	-	(5)	-		11	2.2	0	.75	≤ 2.5 mg/l
Oil & Grease mg/l	24	60	2	10	-	(5)	-		2	12	11	11.5	
Phenols ug/l	24	68	1	12	-	(5)	-		11	500(6)	0	.60	
Cyanides mg/l	21	.0130	0	.0030	-	(5)	-		10	.007	0	.001	
Iron mg/l	28	5.10	.13	.89	-	(5)	-		9	.9	.1	.36	
Coli.bact.MPN/100ml	31	25,000	60	1100(4)	-	(5)	-		5	4000	400	1473(4)	
Fec.Coli.MPN/100ml	30	3400	10	280(4)	-	(5)	-		11	2000	10	57(4)	(4) ≤ 1000/100ml
Fec.Strep.MPN/100ml	30	130,000	10	460(4)	-	(5)	-		6	200	20	75(4)	
Water Temp. °C	27	28.3	3.3	16.1	-	(5)	-		15	27.2	6.7	17.8	≤ 33.9
pH Units	30	8.1	7.0	7.6	-	(5)	-		15	8.1	7.2	7.6	6.0 - 9.0

TABLE 46 (Continued)
SUMMARY OF WATER QUALITY MEASUREMENTS - CALUMET RIVER
(Data from Samples Collected by Metropolitan Sanitary District and State of Illinois)

Parameter	1967 N	1967 Max	1967 Min	1967 Mean	1968 N	1968 Max	1968 Min	1968 Mean	1969 N	1969 Max	1969 Min	1969 Mean	Criteria
	CALUMET RIVER AT TORRENCE AVENUE												
Ammonia N-N mg/l	29	5.4	.7	2.3	4	1.2	.9	1.08	6	12.2	.05	9.58	≤ 2.5 mg/l
Oil & Grease mg/l	25	24	1	7	4	6	3	4.5	1	8	8	8	
Phenols ug/l	28	45	2	9	3	4	0	2	6	1500(7)	0	0.5	
Cyanides mg/l	23	.04	0.0	.0085	3	.001	0.0	.0003	3	.029	0.0	.001	
Iron mg/l	28	1.70	.10	.87	4	1.2	0	.95	6	3.1	.06	1.45	
Coli.bact.MPN/100ml	31	17,000	120	720(4)	4	16,000	1000	2000(4)	5	2,400,000	100,000	552,000(4)	
Fec.Coli.MPN/100ml	31	3400	30	210(4)	4	12,000	100	300(4)	10(8)	500,000	7700	68,000(4)	(4) ≤1000/100ml
Fec.Strep.MPN/100ml	30	70,000	10	580(4)	4	3,000	120	218(4)	4	22,000	500	5120(4)	
Water Temp. °C	27	27.2	3.9	17.8	10	28.3	20.0	23.3	11	25.0	3.3	14.4	≤ 33.9
pH Units	29	8.0	6.9	7.4	4	8.0	7.5	7.7	12	7.8	7.1	7.5	6.0 - 9.0

(1) Illinois SWB-15 Criteria.
(2) Based on SWB-15 rule 1.07(10c) which requires that the effluent shall not raise the stream concentration above 2.5 mg/l.
(3) Did not use one sample which had a value of 14,000 ug/l of phenol for calculation of value.
(4) Geometric mean.
(5) No data for 1968.
(6) Did not use one sample which had a value of 500 ug/l of phenol for calculation of average values.
(7) Did not use one sample which had a value of 1500 ug/l of phenol for calculation of average value.
(8) In violation of fecal coliform - more than 10 percent of samples exceed 2000/100ml.
≤ Equal or less.
N - Number of Samples.

TABLE 47

CALUMET RIVER - LAKE SIDE OF O'BRIEN LOCKS
SUMMARY OF EVALUATIONS OF TRENDS IN WATER QUALITY
January 1967 - December 1969

Parameter	Apparent Improvement	Apparent Degradation	No Apparent Change
CALUMET RIVER AT EWING AVENUE			
Coliform bact., MPN/100 ml.....			X
Fecal Strep., MPN/100 ml.....			X
Fecal Coli., MPN/100 ml.....*			X
pH, Units.....*			X
Ammonia N-N, mg/l.....**	X		
Iron, mg/l.....			X
Phenols, ug/l.....		X	
Oil and Grease, mg/l.....			X
Cyanide, mg/l.....			X
CALUMET RIVER AT 130TH STREET			
Coliform bact., MPN/100 ml.....			X
Fecal Strep., MPN/100 ml.....	X		
Fecal Coli., MPN/100 ml.....*			X
pH, Units.....*			X
Ammonia, N-N, mg/l.....**	X		
Iron, mg/l.....			X
Phenols, ug/l.....			X
Oil and Grease, mg/l.....			X
Cyanide, mg/l.....			X
CALUMET RIVER AT TORRENCE AVENUE			
Coliform bact., MPN/100 ml.....		X	
Fecal Strep., MPN/100 ml.....		X	
Fecal Coli., MPN/100 ml.....**		X	
pH, Units.....*			X
Ammonia N-N, mg/l.....**		X	
Iron, mg/l.....			X
Phenols, ug/l.....			X
Oil and Grease, mg/l.....			X
Cyanide, mg/l.....			X

* Parameter included in water quality criteria.
** Parameter included in water quality criteria and water quality criteria violated.

Beach Sampling Stations. Six Lake Michigan beaches in the Calumet Area were sampled for bacterial quality twice each week during the 1966, 1967, 1968, and 1969 bathing seasons. The beaches sampled were Rainbow Beach, Calumet Park Inner Beach, Calumet Park Outer Beach, Hammond Beach, Whiting Beach, and East Chicago Beach. Both Rainbow and Calumet Park Inner Beaches were sampled at two points. The Hammond Beach on Wolf Lake was also sampled. The location of each beach is shown on Figure 4.

Samples were obtained in four feet of water at elbow depth by samplers who waded into the lake wearing rubber waders. The purpose of the rubber waders was to prevent contamination of the sample by the sampler. The samples were immediately stored on ice and are processed by the laboratory within a few hours of collection. Samplers recorded the following information at the time of collecting the sample: number of bathers within 100 feet, air temperature, water temperature, wind speed and direction, height of waves, cloud and weather conditions and any other factors that may have affected water quality.

The criteria for determining satisfactory water quality for bathing at the Calumet Area beaches are the following:

a. The water quality is satisfactory if MF coliforms are less than 1000 and MF fecal streptococci are less than 100 per 100 milliliter (ml) of sample.

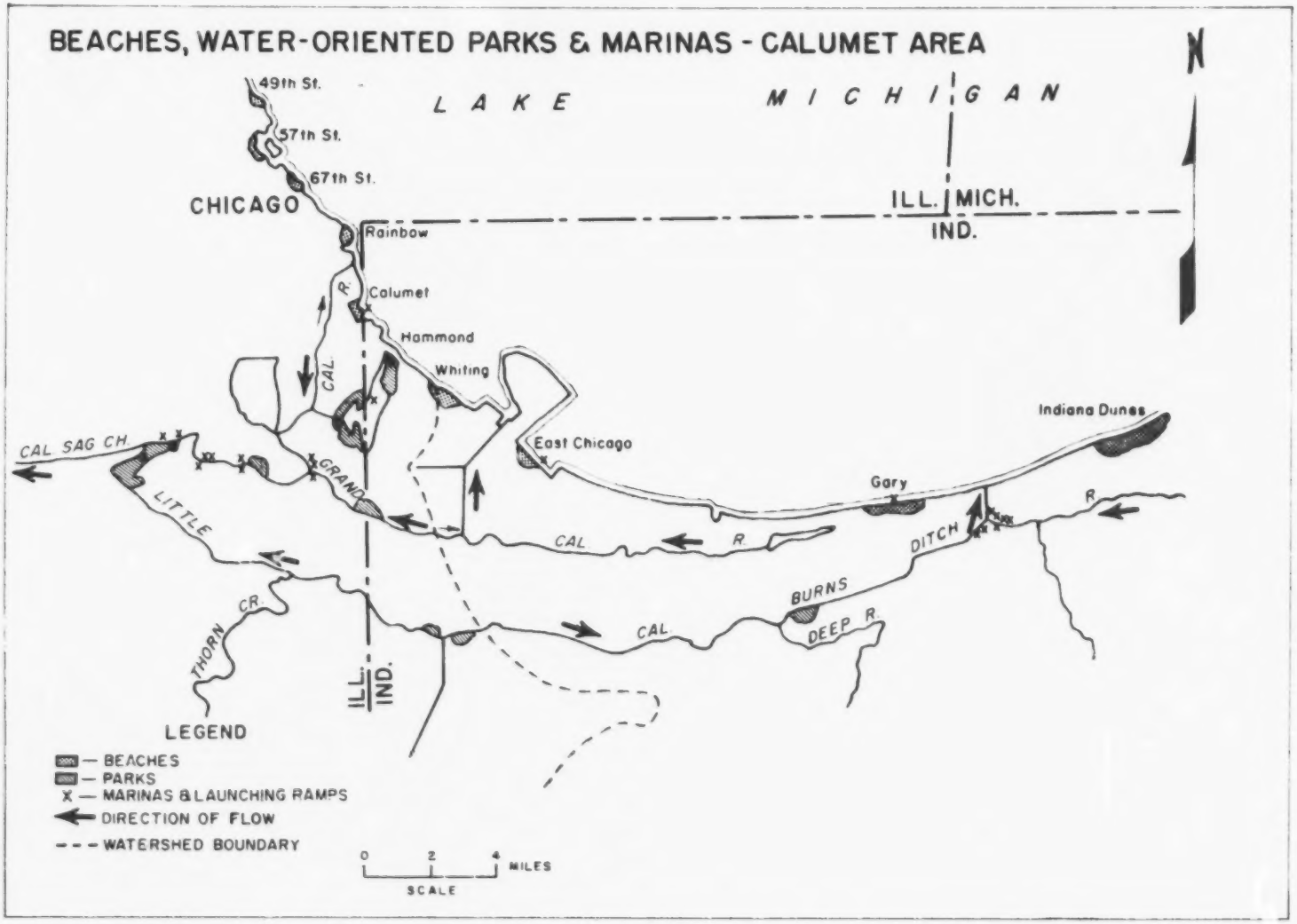

BEACHES, WATER-ORIENTED PARKS & MARINAS - CALUMET AREA
LAKE MICHIGAN
49th St.
57th St.
67th St.
CHICAGO
ILL. MICH.
IND.
Rainbow
Calumet
R
Hammond
Whiting
CAL
East Chicago
Indiana Dunes
Gary
CAL SAG CH
GRAND
LITTLE
CAL R
DITCH
R
BURNS
DEEP R
CAL
THORN CR
ILL.
IND.
LEGEND
BEACHES
PARKS
MARINAS & LAUNCHING RAMPS
DIRECTION OF FLOW
WATERSHED BOUNDARY
0 2 4 MILES
SCALE

Figure 1

b. The water quality is satisfactory if MF coliforms are between 1000 and 5000 and MF fecal streptococci are less than 20 per 100 ml of sample.

An average of the five most recent counts is used to determine if the water quality is satisfactory.

(a) Results of 1967 Beach Sampling. During the 1967 bathing season, all the Chicago beaches sampled showed considerable improvement in bacterial water quality over the preceding season. This is seen in Figures 5, 6, & 7 which graphically depict the maximum, mean and median values for total coliform, fecal streptococci, and fecal coliform, respectively, observed during the study period. Although all the beaches still failed to meet criterion limits on a number of occasions, the frequency of such failures was reduced by up to 45%. Table 43 shows that Calumet Park Outer Beach improved most notably to a point where the water quality was similar to that at Rainbow Beach. Calumet Park Inner Beach at 100th Street showed the least improvement, being polluted roughly 40% of the time.

A period of gross bacterial contamination occurred from July 6 to July 12. The massive alewife die-off that occurred prior and during the period left the beaches covered with dead and decomposing fish. The alewives provided a rich environment in which bacteria could multiply rapidly, and therefore are the most probable cause for the high bacterial counts during July. Another factor is that the winds on sampling days were predominantly easterly during late June

and the first half of July. These winds not only brought in more alewives, but prevented polluted water near the shore from being dispersed into the lake.

The three Lake Michigan beaches in Indiana (Hammond, Whiting and East Chicago) failed to meet the criteria during 1967 more than 75% of the time. Table 48 and Figures 5,6 and 7 show a slight improvement in water quality at Hammond and Whiting, but that East Chicago beach was polluted more often during 1967 than during 1966. The sources of pollution on these beaches are Indiana Harbor and combined sewer overflows from Hammond, Whiting and East Chicago. The Hammond beach on Wolf Lake met the criteria on all occasions during 1967.

(b) Results of 1968 Beach Sampling. During the summer of 1968 the bacterial water quality of the Chicago beaches studied (Rainbow, Calumet Park Outer, and Calumet Park Inner) deteriorated from the condition found in 1967. Violation of the criteria was more frequent in 1968 except at the Calumet Park, Inner beach at 100th St., which showed some improvement (Table 48).

Massive bacterial contamination occurred on or near June 25 and to a lesser extent on July 18, 25, and August 1. A large rainstorm occurred on June 25. Northeast winds prevailed at that time and apparently trapped on the beaches much of the bacterial pollution flushed by the stormwater. Between July 18 and August 1 the prevailing winds were shoreward during the days that high counts were observed. However, little precipitation was evident during this time.

On August 17, heavy rainfall occurred throughout the area. To avoid flooding, the locks on the Chicago River were opened, allowing water which was grossly polluted by combined sewers to flow into Lake Michigan. Apparently, the west and southwesterly winds that followed the storm swept much of the pollution out into the lake since noticeably high coliform counts were not evident at the South Chicago beaches by the 19th, only two days after the storm.

The Lake Michigan beaches at Hammond and Whiting showed some improvement in the 1968 season. However, conditions must still be considered critical, since violations of the criteria occurred more than 64% of the time. The beach at East Chicago showed much more improvement in water quality than either Hammond or Whiting. The frequency of criteria violation dropped 50% in 1968. As with the Chicago beaches, violations were more frequent when easterly winds were prevalent. The Hammond beach on Wolf Lake showed violations of the criteria for the first time during the study period. Over 20% of the samples failed to meet the criteria, whereas during previous years no failures were found.

The data indicates that the heavy use of a beach by bathers increases the coliform counts somewhat but not enough to cause extensive violations of the criteria. During 1967 Rainbow beach and the beaches in Calumet Park were not used extensively for bathing because of the alewife problem. The bacterial counts during 1967 were somewhat lower than during 1968 when these beaches were used heavily. This

difference did not occur on the Hammond or Whiting beaches where bathing is very light or at the water intakes where there is no bathing.

(c) Results of 1969 Beach Sampling.

(1) Rainbow Beach. During 1969 the water quality at Rainbow Beach deteriorated from the condition in 1968. At 75th Street, 45% of the samples did not meet the criteria during 1969, and 52% of the samples did not meet the criteria at 77th Street. The average total coliform counts were 2970 per 100 ml at 75th Street and 3650 per 100 ml at 77th Street. These are higher than the 1968 averages which were 1180 per 100 ml and 1390 per 100 ml, respectively.

The average total coliform count of 9 samples collected at the Dunne Crib water intake during the bathing season was 25 per 100 ml. Coliform counts at this and the other open lake stations have been decreasing since 1967. The higher counts along the shore are localized and appear to be a function beach usage as well as outside contamination.

The lowest median counts on the normally popular beaches occurred during 1967 when a severe alewife problem greatly reduced beach usage. Since then the beach usage has increased each year because the alewife problem decreased. The beach usage at 77th Street is greater because the beach house is located there. The average total coliform counts during 1968 and 1969 were higher at 77th Street than at 75th Street, but the median counts were lower. The median counts can be interpreted as indicative of the normal situation whereas the average counts are influenced by the higher counts found during periods of contamination. The results indicate

that 77th Street is normally slightly cleaner than 75th Street, but when contamination is present, it is more severe at 77th Street. This is consistent only if the source of the contamination is the bathers themselves.

(2) Calumet Park Beaches. Total coliform counts at the three Calumet Park beaches have not varied greatly since 1966. The counts have been slightly lower at the outer beach than at the inner beach which is more heavily used. The medians at these beaches are slightly higher than the medians at Rainbow Beach which indicates that there is more contamination reaching them than at Rainbow. The average counts and the percentage of failure to meet the criteria are almost the same as at Rainbow Beach, however.

(3) Hammond Beach. The Hammond Beach is severely polluted due to combined sewer discharges to Lake Michigan and has been closed for many years. It is not used for bathing at all. The water quality at the beach is still bad, but it has been improving steadily since 1966. 13% of the samples met the criteria during 1969 and the median and average coliform counts were significantly lower during 1969. This is in agreement with data from the Hammond Water Intake where 9 samples taken during the bathing season had an average total coliform count of 1450 per 100 ml. This is considerably lower than similar averages during previous years, 3700 per 100 ml in 1968, 12,000 per 100 ml in 1967, and 5000 per 100 ml in 1966.

(4) Whiting Beach. Whiting Beach is open to bathing, but it is not heavily used due, in part, to the amount of contamination present.

During 1969 the average coliform count was 34,500 per 100 ml and 84% of the samples failed to meet the criteria. The total coliform counts have not changed significantly since 1966. The yearly averages, medians and maximums have been almost constant.

(5) East Chicago Beach. During 1969 the water quality of the East Chicago Beach was better than in previous years with the exception of one sample that had a total coliform count of 260,000 per 100 ml. 55% of the samples failed to meet the criteria and the average coliform count was 5400 per 100 ml (discounting the high value). This is not significantly different from previous years.

(6) Wolf Lake Beach. The water quality at Wolf Lake Beach has continued to deteriorate. 26% of the samples failed to meet the criteria during 1969. The yearly average total coliform count was 1180 per 100 ml which is the highest since surveillance began.

The fecal streptococci data gives the same general picture of each beach as the total coliform counts. The fecal coliform data is totally different, however, indicating dramatic improvement at almost all beaches. This difference in results is important because of proposals to use fecal coliforms as a criterion parameter in lieu of total coliform and fecal streptococci.

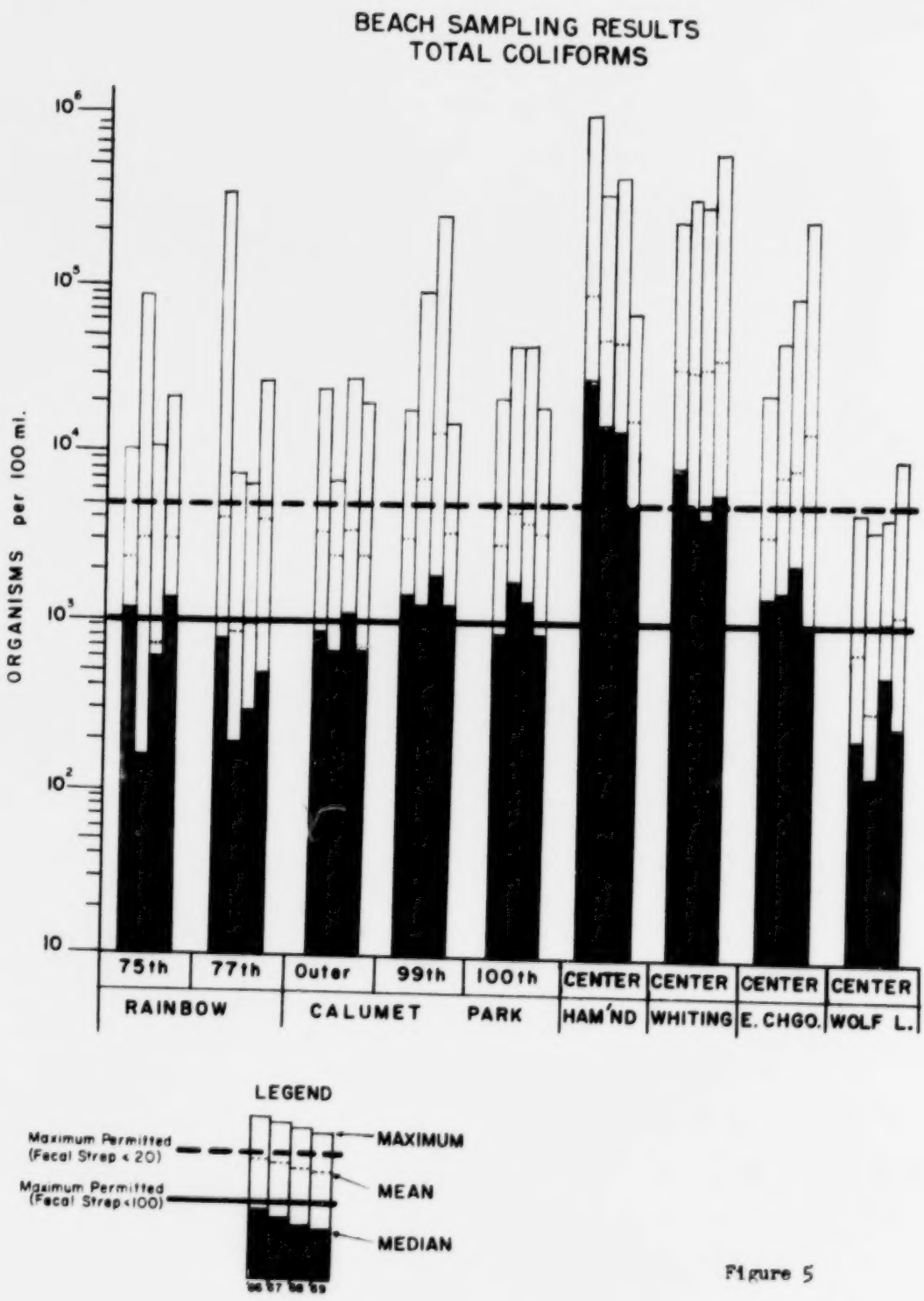

BEACH SAMPLING RESULTS
TOTAL COLIFORMS
ORGANISMS per 100 ml.
10⁶
10⁵
10⁴
10³
10²
10
75th
77th
Outer
99th
100th
CENTER
CENTER
CENTER
CENTER
RAINBOW
CALUMET PARK
HAM'ND
WHITING
E. CHGO.
WOLF L.
LEGEND
Maximum Permitted (Fecal Strep < 20)
Maximum Permitted (Fecal Strep < 100)
MAXIMUM
MEAN
MEDIAN

Figure 5

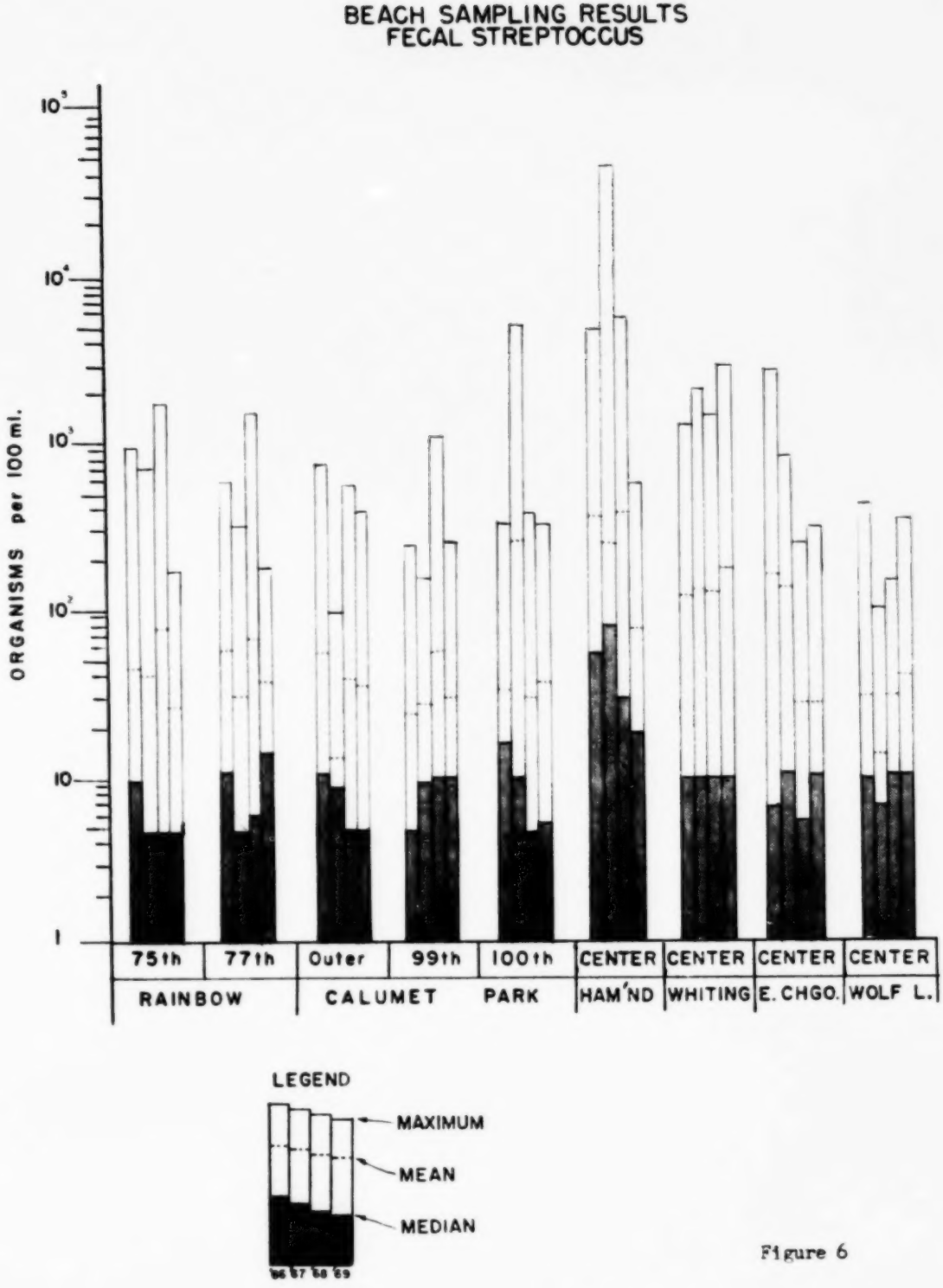

BEACH SAMPLING RESULTS
FECAL STREPTOCCUS
ORGANISMS per 100 ml.
10⁵
10⁴
10³
10²
10
1
75th
77th
Outer
99th
100th
CENTER
CENTER
CENTER
CENTER
RAINBOW
CALUMET
PARK
HAM'ND
WHITING
E. CHGO.
WOLF L.
LEGEND
MAXIMUM
MEAN
MEDIAN
'66 '67 '68 '69

Figure 6

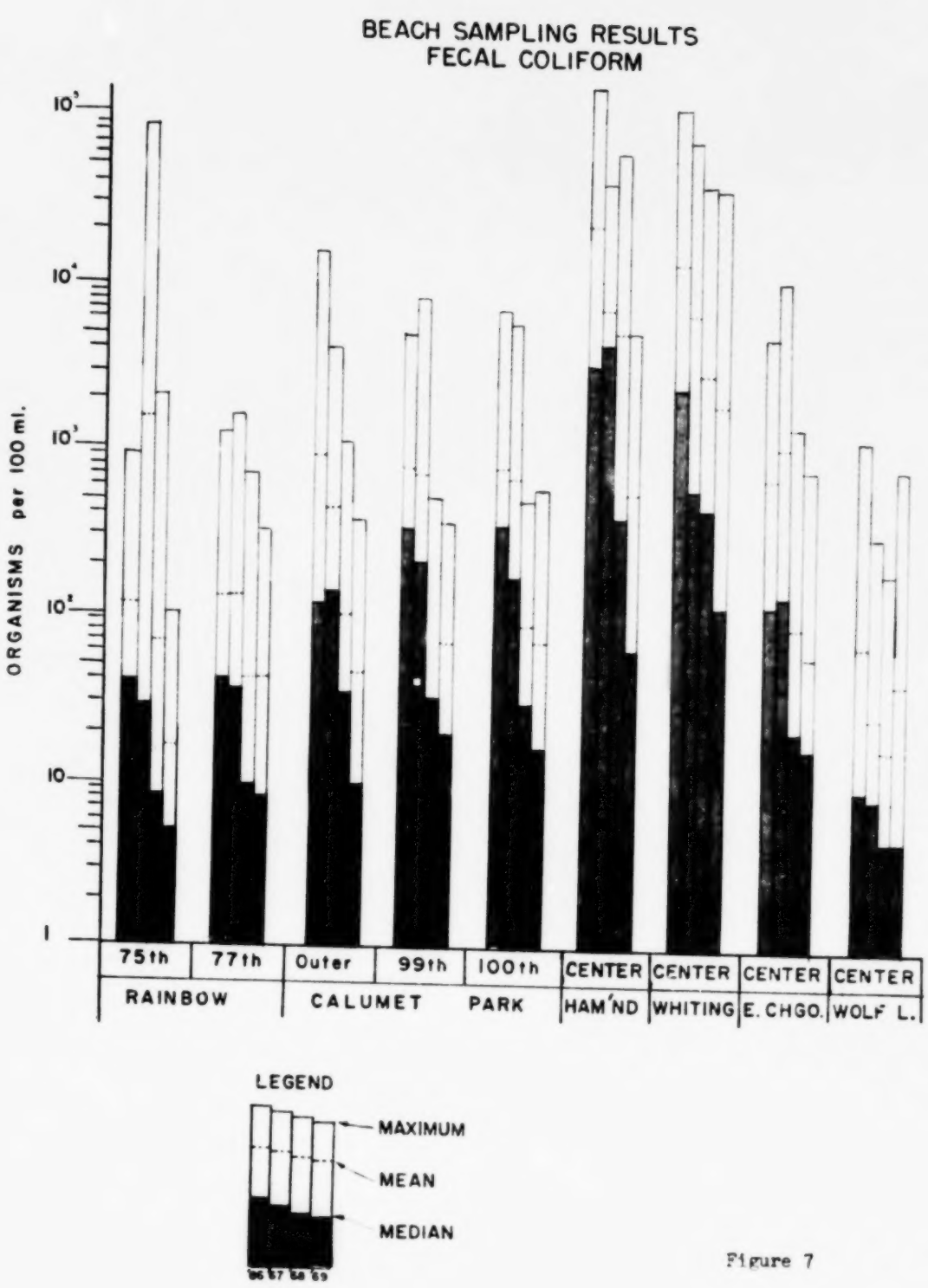

BEACH SAMPLING RESULTS
FECAL COLIFORM
ORGANISMS per 100 ml.
10⁵
10⁴
10³
10²
10
1
75th
77th
Outer
99th
100th
CENTER
CENTER
CENTER
CENTER
RAINBOW
CALUMET PARK
HAM'ND
WHITING
E. CHGO.
WOLF L.
LEGEND
MAXIMUM
MEAN
MEDIAN
66 67 68 69

Figure 7

TABLE 48
FREQUENCY OF CRITERIA VIOLATIONS AT CALUMET AREA BEACHES

Beach	1966		1967		1968		1969	
	No. of samples	Percent of Failures	No. of samples	Percent of Failures	No. of samples	Percent of Failures	No. of samples	Percent of Failures
Rainbow - 75th St.	31	36	33	12	34	32	31	45
Rainbow - 77th St.	31	42	32	16	34	27	31	52
Calumet Park-Outer	31	61	32	16	34	27	31	42
Calumet Park-Inner 99th St.	32	62	33	33	34	50	31	45
Calumet Park-Inner 100th St.	31	58	33	40	34	24	31	55
Hammond	32	97	33	91	34	64	31	87
Whiting	31	94	33	79	33	64	31	84
East Chicago	32	56	33	76	33	36	31	55
Wolf Lake 121st St.	32	0	32	0	33	21	31	26

VII. FUTURE WATER QUALITY

Projected Waste Loads

(a) Indiana. The work completed in the past year and scheduled for completion not later than June, 1970, by the major steel mills with discharge to the Grand Calumet River - Indiana Harbor area should be reflected by a material improvement in effluent quality. The 1968 and the projected daily net discharge in 1970 after the improvements are completed are shown as follows:

Industry		Flow mgd	Suspended Solids lb/day	Oil lb/day
Inland Steel Company, East Chicago	1968	913	127,363	20,815
	1970	910	75,000	12,000
Youngstown Sheet and Tube, East Chicago	1968	324	74,347	15,715
	1970	200	20,000	8,000
U.S.Steel Corp., Gary	1968	536.9	198,088	44,371
	1970	535	104,000	35,000
TOTAL	1968	1773.9	399,798	80,901
	1970	1645.0	199,000	55,000

In addition, there is no effluent to the River from Georgia Pacific Corporation, Gary, as it now provides primary treatment and discharge of effluent to the Gary Sanitary District. The major oil refineries with additional waste treatment facilities to be completed in 1970 and 1971 will make substantial reductions in BOD, suspended solids, oil, phenol, and NH_3.

Reductions in phosphorous are not contemplated until 1972 when phosphorous discharges are to be reduced by 80 percent. Satisfactory

conditions will not be maintained at all times until treatment and/or control of storm and combined sewer overflows and surface runoff is provided.

(b) Illinois-Metropolitan Sanitary District of Greater Chicago-Lake Side of O'Brien Locks. Effluent discharged into the Calumet River Lake side of the O'Brien Locks will be in substantial compliance with effluent standards upon completion of projects presently under construction. All necessary projects are scheduled for operation by December 13, 1970.

To make an estimate of water quality for 1971 of the Calumet River-Lake Side of the O'Brien Locks, a study was made of the four large steel mills in this area. These mills are the largest dischargers into the Calumet River. The other dischargers in this area are rather small and they will be improving on their effluent discharges before 1971.

The Table below lists the daily total pounds discharged by the United States Steel, Interlake Steel-Chicago Plant, Republic Steel, and Wisconsin Steel for 1968 and their estimate for 1971.

Industry		Flow mgd	Discharge, lb/da			
			Sus. Solids	Hexane Solubles	Cyanides	Phenolics
U.S. Steel	1968	200	399,300	56,000	1,100	73
South Works	1971	100	20,850	12,500	16.7	73
Republic Steel	1968	85	50,357	5,616	190	53
Chicago	1971	85	17,723	5,600	17.7	14
Interlake	1968	39.3	20,600	18,800	34.8	77.4
Steel, Chicago	1971	4.0	834	167	0.3	0.6
Wisconsin	1968	86	30,900	1,284	73.6	57.2
Steel, Chicago	1971	28	5,838	1,170	2.4	2.4
TOTAL	1968	410.3	501,157	81,700	1,398.4	260.6
	1971	217	45,245	19,437	37.1	90.0

Intermittent violations of water quality criteria will occur after completion of proposed pollution control facilities due to debris, oil and other floating or dissolved materials attributal to boat traffic, industrial waste treatment plant breakdown, poor shore maintenance and combined sewer overflows.

Projected Water Quality.

(a) Indiana.

(1) Grand Calumet River-Indiana Harbor Canal (Station 6 Control Point). With all the variables inherent in the Grand Calumet River - Indiana Harbor complex it is difficult to predict water quality characteristics in the receiving waters. It is indicated that there will be a 50 percent reduction in suspended solids (from about 400,000 pounds per day to about 200,000 pounds per day) and a comparable percentage-wise reduction in BOD when facilities now under construction have been completed. Substantial reduction in oil, phenols, and ammonia nitrogen are anticipated upon completion of projects now under construction. Meetings have been held with major steel mills relative to the necessity for a reduction in effluent loads.

All water quality criteria at Station 6 control point will not be met when the facilities under construction and planned are completed. Municipalities must provide treatment and/or control of storm and combined sewer overflows and industries must provide treatment and/or control of contaminated surface runoff. Intermittent violations will occur due to debris, oil, and other materials attributed to boat traffic, waste water treatment plant breakdowns, and accidental spills.

(2) Grand Calumet River-West to Illinois (Station 7 Control Point). Water quality criteria at Station 7 control point will not be met until the Hammond Sanitary District provides advanced waste treatment at its waste water treatment plant and provides treatment and/or control of storm and combined sewer overflows.

(3) Little Calumet River-West to Illinois (Station 8 Control Point). Water quality criteria at Station 8 control point will not be met until the combined sewer overflows originating in Hammond, Munster, Highland, and Griffith receive adequate treatment and/or control.

(4) Wolf Lake (Station 9 Control Point). Water quality criteria at the Station 9 control point will not be consistently met until effective control is provided for nutrient additions and storm water discharges.

(b) Illinois-Metropolitan Sanitary District of Greater Chicago-Calumet River-Lake Side of O'Brien Locks (Station 11 Used as Control Point). Water quality in the Calumet River lake side of the O'Brien Locks will be in substantial compliance with State Standards upon completion of present steel mill construction projects. Intermittent violations will occur due to debris, oil and other floating materials attributal to boat traffic, industrial waste treatment plant breakdown, poor shore maintenance, and combined sewer overflows.

Frequent violations of ammonia nitrogen, total phosphorous, and filterable solids will occur at Station 11 located at the mouth of the Calumet River.

Ammonia Nitrogen: Ammonia nitrogen will not consistently meet Calumet Harbor control point criteria at Station 11 when present

construction is completed. The Illinois SWB-15 requirement for effluents to waters of the State within the Metropolitan Sanitary District of Greater Chicago limits effluent concentrations to a level that will not raise concentrations in streams above 2.5 mg/l. The Illinois SWB-7 Calumet Harbor standard has allowable daily concentration at Station 11 of 0.12 mg/l. Station 11 should not be evaluated by Calumet Harbor Control Point Standards.

Dissolved Iron: Dissolved iron will meet control point criteria upon completion of United States Steel and Interlake Steel Blast Furnace Gas Washer Water Recycle Systems.

Phenol: Phenol will meet criteria upon completion of Steel Mill projects.

Total Phosphorous: Total phosphorous will not consistently meet criteria under present construction program. Combined sewer overflows must be eliminated and industrial waste treatment plant effluents improved.

Filterable Solids: Filterable solids will not consistently meet criteria. Combined sewer overflows must be eliminated and industrial waste treatment plant effluents improved.

pH: The pH will meet criteria upon completion of Steel Mill projects. Annual average violations could result even though daily violations do not occur due to variation in criteria.

(c) Municipal Water Supply Sampling Stations (Station 14, 15, 16, and 17 Control Points). Because of the complexity of the waste management problems in the Calumet Area, it is difficult, if not

impossible, to make an accurate quantitative estimate of the effects of pollution abatement measures on water quality in Lake Michigan. Water quality at the Lake Michigan sampling stations is largely dependent on maintaining water quality at the Station 6 control point at the mouth of the Indiana Harbor Canal and at Station 11 at the mouth of the Calumet River, and on controlling direct discharges to Lake Michigan in the Calumet Area. The problem is further complicated because the concentrations of many materials may, over time, be increased because of discharges at distant points in Lake Michigan with subsequent transport by Lake currents to the Calumet Area. Continued water quality surveillance is the only accurate method to determine current water quality or trends in changing water quality. Station 16 at the Hammond Water Supply Intake is located in the Inner Harbor Area approximately half way between Station 11 at the mouth of the Calumet River and Station 6 at the mouth of the Indiana Harbor Canal (Figure 3). Water quality measurements at Station 16 are therefore a good measure of the effects of pollution entering Lake Michigan from the Calumet River and Indiana Harbor Canal.

The measured values of water quality parameters at Station 11 and Station 6 were compared with the concurrently measured values at Station 16 by linear regression equations to determine the measured relationship between the values of water quality parameters at the major points of inflow to the Inner Harbor Area with the measured values in the Inner Harbor Area. These comparisons apply only to the conditions that existed when the water quality measurements were made. On the

basis of these comparisons, when the Indiana SPC 7 Indiana Harbor Canal Criteria are met at Station 6, and the Illinois Calumet Harbor Basin Criteria (Indiana SPC 6 Lake Michigan Inner Harbor Basin Criteria) are met at Station 11, the Lake Michigan Inner Harbor Basin Criteria at the Station 16 Hammond Water Supply Intake control point will generally not be violated. The immediate problem is to complete the pollution abatement measures required to obtain compliance with water quality standards at the mouth of the Indiana Harbor Canal and the Calumet River.

Similar calculations show that a measured improvement in water quality at the other Lake Michigan sampling stations generally occurs concurrently with a measured improvement in water quality at Station 16.

LOCATION MAP-CALUMET AREA
PRINCIPAL SOURCES OF WASTES
MUNICIPAL:
Hammond STP
East Chicago STP
Gary STP
INDUSTRIAL:
Cargill Corporation
Interlake Steel
Wisconsin Steel
Republic Steel
United States Steel
American Maize
American Oil
Atlantic Richfield
Cities Service
Inland Steel
U. S. Gypsum Co.
United States Steel
Youngstown Steel
Lake Michigan
Chicago
Lake Calumet
Calumet R.
Wolf Lake
O'Brien Locks & Dam
Blue Island
Riverdale
Burnham
Dolton
Harvey
Calumet City
South Holland
Thornton
Homewood
Glenwood
Chicago Heights
Park Forest
Lansing
Hammond
East Chicago
Indiana Harbor Canal
Grand Calumet R.
Gary
Munster
West Creek
Highland
Griffith
Dyer
Schererville
Little Calumet
East Gary
New Chicago
Hobart
Turkey Ck.
N
ILLINOIS
INDIANA

Figure 8